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OBSERVATIONS UPON THE HABITS, STRUCTURE AND DEVELOPMENT OF AMPHIOXUS LANCEOLATUS.

BY HENRY J. RICE.

See Popular Science Review May, 1880. 448.

PREVIOUS to last season, specimens of that very curious fish-like animal, *Amphioxus lanceolatus* Yarrell, had been discovered along the eastern coast of the United States only in Florida and North Carolina, and one specimen, according to Mr. P. R. Uhler, president of the Maryland Academy of Science, upon the Eastern Shore of Virginia. While engaged in laboratory work at the Chesapeake Zoölogical Laboratory, at Fort Wool, last summer (1878), I was fortunate enough to obtain possession of three adults—two males and a ripe female—and twenty specimens of the young of this very interesting species, thus making Fort Wool not only a new locality for the adult animal, but, so far as I am aware, the only place in America where the young have ever been captured.

Of these specimens the adults were taken with the dredge from the bottom of the bay, south and east of the fort, in a depth of water of from twelve to fifteen feet, and the young were secured by surface dredging with small hand-nets of bolting cloth, from around the wharf, and near the steps of the boat-landing. While they remained alive, which was during the greater part of the months of July and August, I had the opportunity of making a very interesting series of observation, in regard to their habits, and those peculiarities of structure and development which have drawn so much attention to this animal, and rank it as at least the lowest of vertebrates, if not an intermediate type between Vertebrata and Invertebrata. These investigations, the results of which

I have embodied in the following necessarily incomplete summary of our present knowledge of Amphioxus, were conducted with a great deal of care, and while they have led me to differ from the commonly received views in regard to certain particulars of structure and development, they have enabled me, by a somewhat detailed comparison of results, to corroborate much of what has already been done in this important field of research.

History.—This apparently insignificant little creature was first made known to science, in the year 1778, from specimens found upon the coast of Cornwall, England, and sent to Peter Simon Pallas, a celebrated German naturalist, who was then issuing his Record of new forms of animal life. The description given in this Record[1] is, in the main, quite accurate, but from some misunderstanding of the nature of the ventral ridges, or perhaps from some slight resemblance to a sea-slug, Pallas considered it a new species of snail, and named it *Limax lanceolatus.* Had he had the opportunity of examining other than contracted specimens of this new form, he probably would not have written, "Tentacles evidently none," and might have hesitated before placing it among the Limacidæ. But if Pallas failed to correctly estimate its generic features, the next writer who mentions it[2] seems to have been able to appreciate them to a certain extent, for he remarks, that it is "hardly a Limax," although for some reason he retained this name, and adds to it, probably through some typographical error the specific term of *lanceolaris,* which ought only to accompany the genitive of Limax, or Limacis. After this notice by Stewart, *Limax lanceolatus* seems to have dropped from the vocabulary of zoölogists and to have passed almost from the memory of those engaged in describing and classifying new species of animals, for in 1834, when Costa[3] discovered this same animal in the Bay of Naples, Italy, he failed to recognize it as having been described before, and considering it a new species of fish, he named it *Branchiostoma lubricum,* from the fact of its having tentacles about the mouth, and upon the supposition that these tentacles subserved the purposes of respiration as branchiæ.

[1] Spicilegia Zoölogica. Peter Simon Pallas. Fasc. x, p. 19. Taf. 1, Fig. 11. Berlin, 1778.

[2] Elements of Natural History. —— Stewart. 2d edition. Vol. 1, p. 386.

[3] Cenni Zoölogici ossia descrizione sommaria di talune specie nuove di animali. O. G. Costa. Page 49. Napoli, 1834. And, Storia el *Branchiostoma lubricum.* Napoli, 1843.

Almost simultaneously with this discovery of Costa, it was rediscovered upon the coast of Cornwall by Mr. Couch, and was recognized by Mr. Yarrell as the *Limax lanceolatus* of Pallas. But Mr. Yarrell also recognized as Costa had already done, and thus corroborating the doubts of Stewart, that instead of being a Limax it was, in reality, closely allied to the class of fishes, and not aware of its discovery in Italy, by Costa, he erected a new genus for it, *Amphioxus* (*Amphi*, on both sides, and *oxus*, sharp, from the fact that both extremities are pointed), and described it in 1836[1] as *Amphioxus lanceolatus.* It will thus be seen that the generic name assigned it by Costa has priority over that instituted by Yarrell, but the term Branchiostoma being founded upon a misconception of the functions of the tentacles, and the specific name of Pallas having priority over all, the name as given by Yarrell, *Amphioxus lanceolatus*, has come, by common consent, to be adopted as the appellation of this small denizen of the sea. Since 1836 Amphioxus has been found inhabiting nearly every quarter of the globe, specimens having been taken in China, Borneo, South as well as North America, and along the entire coast of Europe, although it has been found most abundantly in the waters of the Mediterranean sea, near Naples and Messina, Italy, where at present the conditions seem to be most favorable for its propagation and growth.

These various specimens, coming from such widely separated localities, were supposed, by their discoverers, to represent distinct species of this animal, and specific names have accordingly been given them, as *Amphioxus belcheri* Gray, for the East Indian form, and *Branchiostoma caribæum* Sundeval, for the form upon our coast, but the best informed European systematists consider that all these forms represent but a single species,[2] the *A. lanceolatus* Yarr., of Europe, which thus becomes one of the most widely distributed, as it is certainly one of the most anomalous of existing animals.[3]

[1] Hist. of Brit. Fishes. Wm. Yarrell. Vol. II, p. 468. London, 1836.

[2] Traité de Zoölogie. Page 808. Paris, 1878. Translated by Prof. G. Moquin-Tandon from the third and latest edition of the Handbuch der Zoölogie of Prof. C. Claus.

[3] Dr. Gill, of the Smithsonian Institution, informs me that Sundeval separated the Caribæan form from that of Europe on account of a difference in the number of plates, or fibers in the muscle-plates, of one form from that of the other. I have not as yet been able to examine the two forms with a view to determine this point.

General Description and Habits.—The adult Amphioxus, Fig. 1, Pl. 1, is a small, rather slender animal, which lives for the greater part of the time entirely buried in the sand along the sandy portions of the shores which it inhabits. When fully grown it is about two inches in extreme length, rarely somewhat longer, and of a pale flesh color which changes, when seen by reflected light, to a beautiful display of metallic iridescence.

Its body is smooth, very muscular, much compressed from side to side, and tapers gradually to the extremities, which are pointed, but differ considerably in contour, for while the posterior is lance-shaped, from whence is derived the specific name of *lanceolatus*, the anterior is formed like the ram of a modern gun-boat, and is admirably well adapted for forcing a way through the sand in which it burrows. The abdominal portion of this blade-like structure forms a dilatable sack which extends from near the anterior end of the body back for about two-thirds the entire length of the animal, where it terminates in an opening, the abdominal pore or branchiopore, which places the cavity enclosed by the sack in communication with the exterior. During the life of the animal this abdominal sack is seen dilating and contracting quite regularly, although at rather lengthy intervals, with a wave-like motion which begins at the forward end of the cavity and travels backward, rather slowly, to the posterior extremity. When the sack is completely distended this portion of the body presents a full, clear, rounded appearance, and projects considerably below the ordinary ventral outline, but when contracted, as it is in all preserved specimens, all appearances of a cavity disappear, leaving merely a slight indentation where the "pore" is situated, between the abdominal and the tail portions.

Through the center of the muscular part of the body, and forming an axial support to the animal, there is a long, slender, semi-cartilaginous rod, which is pointed at each end, and which extends from the very point of one extremity to that of the other. This rod is composed of an external membraneous sheath enclosing a series of closely approximated flattened disk-like bodies, and is probably the homologue of the vertebrate notochord, or backbone, although not exhibiting any anterior cranial expansion. Above it, but not extending quite as far forward, is the main nervous system, or chorda dorsalis, and below it lies the long, nearly straight alimentary canal. This canal opens anteriorly by a longitudinal

aperture, the mouth, placed upon the median, ventral line just behind the depressed ram-like termination of the body, and between it and the anterior portion of the abdominal cavity. This oral opening is of moderate size, and is surrounded by about thirty-one tentacles which are moderately long and slender, and bear upon their sides little protuberances which give them a toothed appearance. The anus, or outlet of the canal, is funnel-shaped, and opens very eccentrically upon the left side of the body just beneath the level of the notochord and *quite* near the end of the tail. The left or free edge of this aperture does not extend at its posterior limits quite down to the ventral edge of the muscle-plates, so that the anus also opens, to a certain extent, *towards* the left side of the body, although the fæces are expelled directly backwards and downwards along the side of the median fin. This free edge is quite flexible and in hardened specimens is so contracted, together with the surrounding parts, that the anal aperture appears to open into a pseudo-cloaca. The integument, which forms the greater part of the mouth tentacles, is thin and nearly transparent, and expands along the entire length of the dorsum, and around the tail, and as far forward as the branchiopore, into a delicate, median fin of nearly uniform width except upon the edges near the posterior extremity, where two unequal lobes are formed which represent the blades of this "lance" termination. Of these two "blades" the ventral is the larger, and its posterior curvature is nearly below the anal opening of the intestine. The integument also forms two longitudinal folds, which extend along either side of the abdomen, from the posterior portion of the mouth orifice where they originate, to the indentation which exists between the abdominal and the tail portions. Here, after forming a sort of triangular pit into which the branchiopore opens, they become merged into the median, ventral fin, which, as already stated, reaches forward to this point. When the abdomen is fully extended these folds become nearly obliterated, and are barely visible as lines running along the sides parallel to and at some distance above the ventral outline; but when the abdomen is strongly contracted they form prominent ridges along the lower edge of the body, and so change the appearance of the specimen that it is not much to be wondered at that Pallas should say, that this portion looked "very much like the very narrow foot of a snail."

These folds are hollow and have been thought, until quite recently, to have an opening at either extremity, but Prof. Ray Lankester denies[1] that there are any such openings, and I have failed to obtain any evidence from my specimens that any such apertures exist. With the exception of these side-folds and the mouth tentacles, the integument presents no appendages whatsoever. External sense-organs are also wanting, except upon the left side of the body near the anterior end of the chorda dorsalis, where a small ciliated pit is said to be located which it is claimed, by Kölliker,[2] its discoverer, and others, represents a nasal depression, or cavity. I have not been able to make out this pit, and even if it is present, it is probable, that these animals gain their impressions of external objects entirely by the general sense of touch.

The adults, while varying somewhat in size, as is the case with most adult animals, do not differ very much otherwise in general appearance except during the breeding season, when the female becomes filled with ova, and the abdominal portion becomes, in consequence, much larger than ordinary. At this period the ova show very plainly as a row of large white spots along either side of the animal, Fig. 1, Pl. I, but at other times, and in the males, there are no such spots visible to the naked eye. These differences of size and sexual appearance were well marked in my specimens, for while they varied in length from $1\frac{1}{16}$th to $1\frac{7}{16}$th inches, thus being of rather small size, the female, which was the largest, was so distended with ova that her body was much rounder, and consequently more opaque in appearance than the bodies of the thinner males. The young, Fig. 5, Pl. I, and Fig. 7, Pl. II, resemble the adults very much in outline, but differ in many points of structure, which will be noticed in treating of their development, and in being quite transparent, looking much like animated bits of isinglass when in the water. This transparency, however, gradually gives place, as they grow old, to a semi-opaque condition which permits the outline of different parts to be made out, but not with any great degree of distinctness unless under a very strong light, and the older and larger the specimen, as a matter of course, the less the distinctness. The young specimens varied in length from $\frac{5}{64}$th to $\frac{5}{16}$th of an inch, although the greater number were about $\frac{2}{16}$th of an inch long.

[1] On some new points in the structure of Amphioxus. Prof. E. Ray Lankester. Quar. Jour. of Micro. Science. Vol. 15, p. 257, 1875.

[2] Müller's Arkiv, p. 32. Berlin, 1843.

All of the above-mentioned specimens which came into my possession, were gathered together during the period from the 9th of July, when the first specimen, an adult, was obtained, to the 2d or 3d of August, after which date no more could be found. The young were taken mostly at night, one or more at a time, when the water was comparatively quiet, but the greatest number captured on any one occasion was at noon of a very hot day, when there was scarcely a breath of wind, and the surface of the bay was almost as smooth as the proverbial "sheet of glass;" these small inhabitants thus seeming to be affected by heat, and especially by a quiet condition of the water, in very much such a manner as are the myriads of other young animals which are floated hither and thither by the currents of the sea at this season of the year. As soon as taken they were transferred to tumblers which had been previously filled with fresh sea-water, and each tumbler was generally occupied by four or five specimens. The water was changed daily in all the vessels. When first placed in these receptacles they darted about with a quick "wiggling" motion which resembled somewhat the movement of a tadpole, but different in that the head, or anterior part of the body, moved from side to side as far and as vigorously as the tail portion. This peculiar undulation was generally kept up for some little time at or near the surface, when suddenly they would cease all motion and allow themselves to sink slowly to the bottom. where they would remain flat upon their sides until again impelled to action. When this impulse came, from whatever cause, and they were once started from their resting place at the bottom, they generally swam directly upward to the surface, moved about here for a short time, and then, as before, suddenly stopped and allowed themselves to sink again to the bottom. But sometimes one of the inhabitants of a dish would start up, seemingly impelled by some willful freak, dash about close over the bottom and stir up all the others in the vessel, when there would be, for a moment or so, quite a brilliant display of undulating, flashing forms.

The largest of these young specimens was pretty well advanced in development, and was placed in a separate dish which had a layer of sand upon the bottom. It was thus isolated for the purpose of ascertaining if it would make use of the sand as a place of refuge, but only on one or two occasions, and then for very

brief periods, did it ever disappear beneath the surface. Generally it lay flat upon the top of the sand, until disturbed from its repose, when its actions closely resembled those of its smaller fellows. Hence it must be at a later period of life than that to which this one had attained, that these little animals cease to be shifted about by the flood and ebb of changing currents, and become "burrowers." The adults, which were taken from the banks by means of the dredge, were placed together in a large jar of sea-water, which was furnished, like the dish of the largest of the young animals, with a layer of sand upon the bottom. When once in the water they commenced swimming about very rapidly, with the same graceful, undulating motion which has been noticed as characteristic of the young, but with much greater vigor and elasticity. These movements were executed sometimes upon the back, sometimes upon the abdomen in the position of ordinary fishes, it seemed to make very little difference which side was uppermost, but I have never seen them move backwards, or tail-end foremost. After circumnavigating the vessel once or twice, gradually moving slower and slower; they would stop and sink down upon the sand at the bottom. Generally as soon as they touched the sand they would half-arch their bodies and almost instantaneously disappear from sight beneath the surface, thus regaining their natural place of refuge. After this disappearance they very rarely entirely emerged from their retreat, and as a rule, not at all during the day time. But if the surface of the sand was carefully examined at night, little spots might be detected where the sand appeared less compact than elsewhere, and a close inspection would discover each such spot to be a network of crossing tentacles arching over the expanded mouth cavity of one of these animals, which was thus, while lying belly upwards buried in the sand with only its mouth exposed at the surface, busily engaged in drawing its food from the water above.

Sometimes they could be found so situated during the day time, and now and then both by day and night, but rarely in the day time, one or more of them could be seen protruding part way from the sand, and looking as if planted in this position, but a tap or a motion of the vessel would cause them to withdraw from sight immediately.

These actions would seem to indicate what is probably a fact,

that the day time is to these animals a period of rest, when they remain entirely buried beneath the surface, and night time a period of activity, when they come up to feed and perhaps to move from place to place, as they have been seen swimming about during the night in the aquarium at the Zoölogical Station at Naples, and on one or two occasions I have found, early in the morning, one of my specimens lying entirely out of the sand, fully exposed to view, and in all probability it had been swimming about during the night.

On account of the propensity of these animals to remain concealed from sight it was necessary, whenever they were wanted for examination, to drive them from the sand, and this was by no means an easy task, as they are such exceedingly active little beasts that they would work their way from side to side of the dish beneath the sand, very nearly as quickly as I could run a stick or pencil through it in trying to find their position. And when once forced out, they would dart through the water so impetuously, and plunge into the sand again so quickly that their movement seemed merely a flash in the water, and a few particles of floating sand and mud would alone indicate that one of them had been out of their proper domain. Generally this chasing process had to be repeated four or five times, when they would become exhausted, and after undulating about the jar very slowly for a moment or so, they would sink upon the sand and remain perfectly quiet, flat upon their sides, for sometimes half a day at a time. During these intervals they could be transferred from dish to dish and even placed under a low power of the microscope for examination. But if not completely exhausted a short rest would revive them, and then, when touched, they would dash away as impetuously as ever, and I have had them, on such occasions, rush out of the water and over the broad rim of a large plate on to the table, and before they could be touched, much less secured, throw themselves off the table and down upon the floor. But the adults appear to be so vigorous that these falls, which occurred on two different occasions, did not seem to have the least injurious effect. As may be surmised from this, all their movements are exceedingly quick, and this rapidity in going through sand and water, and hence the ease with which they can move about from place to place, is probably the reason why we secured only three of these animals at Fort Wool.

We made a large number of dredgings but the dredge used was too coarse and heavy for such work, and as we had had no idea of finding Amphioxus at this place, we were unprovided with one of suitable construction. It is probable that with a proper dredge, perhaps a ring dredge, made light and with fine meshes, they could be taken in this locality in fair numbers, and it is possible that places might be found along our coast, if searched for, where they could be taken in as great abundance as at Naples and Messina, in Italy. And where the adults are found the young could be taken also, if looked for during the breeding season, which in this country is probably during the months of June and July. I base this statement upon the facts that my young specimens, which were somewhat advanced in development, were taken mostly during the second and third weeks of July, and that only one specimen could be secured after the close of that month. Amphioxus does not appear to be a difficult animal to keep if supplied with plenty of sand in which to burrow, and a daily change of water of a density equal to that which is found at the place of its capture, My adults remained alive and appeared to be in fine condition as long as I could give them water which came in fresh from the sea every day, but in September they were carried up the bay to Tangier's sound, where being unable to supply them with suitable water they soon showed unmistakable signs of debility, and on the 10th inst. they were placed in picric acid to be ready for future service. None of the young remained alive as long as did the adults, and only a few grew so well and appeared so vigorous as to indicate that they would reach maturity. Some of them, from some cause, became dwarfed and drawn out of shape so as to look, in one or two cases, like a large letter S, and others, probably from the erosive or wearing action of bits of sand, or something of the kind, which had entered the stomach and intestines along with the food, had lost portions, and sometimes half of their bodies, and yet these little deformed and maimed animals lived sometimes for a week in such condition, evincing certainly a good degree of vitality, and enabling us, if Amphioxus is really one of the earliest of animals, the better to appreciate the "why and the wherefore" of the persistence of this species to present time.

The Skeleton.—The framework of Amphioxus is entirely cartilaginous, and is composed of the notochord; a series of processes

said to represent spinous processes, which extend along nearly the entire length of the dorsum, and along the ventral side of the tail portion of the animal; and a series of arches or supports which are formed along and in the sides of the anterior half of the alimentary canal. The *notochord* has already been described, and its position defined as forming an axial support extending from end to end of the body, and representing the back bone of higher vertebrates, but lacking the anterior expansion or brain case. The *spinous processes* form rows of semi-transparent, perpendicularly placed, block-like bodies; the dorsal row originating over the chorda dorsalis, and rising upwards from between the side muscles to form a median basal support to the dorsal fin; and the ventral row originating beneath the intestine and extending out from between the side-muscles to form a support to that portion of the median fin which extends from the branchiopore back to the ventral "blade" of the tail. These blocks are well marked, and form quite a prominent border to the greater part of the outline of the muscular portion of the body. (Figs. 1 and 5, Pl. I, and Fig. 7, Pl. II.) The series of bodies pertaining to the alimentary canal consist of a mouth ring, a pharyngeal ring and a variable number of rib-like arches placed alternately upon either side of the canal and extending back to about the middle of the body. These different parts are unconnected above, unless it may be to a slight extent with the sheath of the notochord, but below, the two rings, which arise from a common base, are connected with the arches by a cartilaginous trough-like formation which extends back as far as the last arch, and in the sides of which the bases of the arches are firmly imbedded. The *mouth ring* is formed in the integument of the edges of the mouth orifice, and arches forward and upward in conformity to the outline of this portion of the body. It is made up of segments, one for each tentacle, and each segment sends out from the side, at the anterior end, a long, slender prolongation which extends, as a central support, to the very tip of its corresponding tentacle. (Fig. 2, Pl. I.) These segments, which are the same in number upon both sides of the mouth, do not unite in front, but form arms which end upon either side just at the base of the ram-like extremity of the body, and at these terminations of the "ring" new segments are formed, when, in the growth of the animal, there is room in the oral circlet for additional tentacles.

The odd tentacle which is found in the mouth circlet of Amphioxus, is formed from the center of the basal portion of cartilage from which the two rings originate. The cartilaginous portions of all these tentacles are curved inward, and so directed that the tentacles in the normal condition always cross each other, much as the fingers of a person's hands can be interlaced, and thus form a rude sieve which prevents the entrance of large substances into the digestive tract. The *pharyngeal ring* which marks off the anterior limits of the abdominal cavity, forms a sort of welt or slight constriction around the inside of the anterior portion of the alimentary canal. It is curved backwards upon both sides, and bears upon the posterior border of each curved portion two or three rather large fleshy-looking tentacles. (Fig. 2, Pl. I.) These tentacles generally lie directed backwards against the side-walls of the digestive tract, but they can be brought forward so as to extend directly across the canal and form a second barrier to the onward progress of large bodies. In the young this barrier is of much greater service in preventing entrance to the digestive tract than the oral tentacles, as these latter appendages are not sufficiently numerous to act as an efficient guard until the animal is of considerable size, as large or larger than the largest of my young specimens. These tentacles are not always of the same size, and are generally so placed upon the sides that when brought forward they alternate one above the other.

The *branchial arches* are frame-like in structure, long and slender in outline, and run obliquely downwards and backwards across the entire width of the canal—this obliquity is such that the center of the upper portion of one arch is about over the center of the lower part of the next arch in front. The arches are quite numerous, fifty, more or less, upon each side, but I am not aware that there is any definite limit to their number, the largest individual appearing to have the most arches. The greater number of them are of uniform length, but as they approach their posterior limits they gradually become shorter and shorter, to the last one or two, which are less than a quarter the length of the longest ones. The first and second arches are also much shorter than the others, and are about the length of the last ones. The first and last arches are very simple in formation. The first is composed of an oblong framework, pointed at the lower end and nearly square or somewhat pointed at the upper. It is about

twice as long as broad, almost upright in position, and is placed just posterior to the lower curvature of the pharyngeal ring. The last one is merely a round or nearly round ring of cartilage. The rest of the arches are shaped much like the first, but are bi-lobed above and have a central bar which passes from the indentation of the bi-lobed end down to the cartilaginous bed which encloses the pointed lower extremity. This bar is about twice as wide as either side of the arch, and is marked throughout its entire length by a median line which indicates a division into two slender halves. In all of the longer arches there are also three cross-bars, which pass from side to side of the arch at about equal distances between the two ends, and in the shorter arches, except the first and last, which contain none, there are sometimes one, sometimes two of these bars in each arch. These bars pass obliquely backwards and upwards across the arch, and generally go directly from one side to the other, but some of them divide at the central bar and become attached to it, so that they form two short bars instead of one long one. The arches of each side are placed close together, edge to edge, so that they have the appearance of a connected, continuous series of long slender oblique bars, each marked by a median division line and separated by a space of about the same width as the bars themselves, and with cross-bars running, with more or less regularity, across these spaces from alternate bars. The upper edge presents a series of uniform lobes, and the lower edge a series of larger uniform arched points, there being left between each two points a triangular space of considerable size. (Fig. 4, Pl. 1, *a*.) Each complete arch is thus made up of two nearly similar halves, and as the arches of the two sides alternate with each other, as has already been said, the triangular spaces at the bases of the arches not only serve to show the divisions between them, but also indicate the positions of the opposite arches. This alternation can be readily seen by placing an adult animal, when living, under a low power of the microscope, or by a careful dissection of this portion of the body.

The Digestive Tract.—The alimentary canal, which extends along beneath nearly the entire length of the notochord, is somewhat compressed from side to side, varies considerably in breadth in different parts, and is lined throught its entire length with cilia which serve by their action to draw food into the canal for the

nourishment of the animal. The canal may be divided into five rather natural divisions; the mouth cavity, extending from the mouth orifice to the pharyngeal ring; the pharynx, the œsophagus and the stomach, extending from the pharyngeal ring to the division between the abdomen and tail, and which hang from their attachment beneath the notochord freely suspended in the abdominal cavity, being completely enclosed by its walls; and the intestine, which extends along through the tail portion of the animal to the anus, near the posterior extremity. The *mouth cavity*, or first division of the canal, is somewhat triangular in shape, being circumscribed above by the notochord, and below and behind by the two orifices already mentioned. Its anterior upper outline is curved, and it bears upon its walls certain slight, finger-like ridges where the cilia of this cavity are principally aggregated.

At the rather constricted opening of the pharyngeal ring it merges into the *pharynx*, which extends a little past the middle of the abdominal cavity, and is the largest division of the canal. This portion is that in which the branchial arches are formed, and has much the shape of a bean pod, being quite broad along the central part and narrower towards each end, but the posterior extremity tapers much more gradually than the anterior, and where it merges into the œsophagus, it is hardly more than half the size of the portion at the pharyngeal ring. Along its sides, in all the spaces between the bars of the branchial arches, there are long narrow openings, called branchial slits, which place the interior of the pharynx in communication with the abdominal cavity, which is also known as the branchial cavity, or atrium, but which might more properly, perhaps, as will be noted later on, be called the *branchium*. These branchial slits extend, with few exceptions, from the upper curves down through nearly the entire length of the arches, to the edges of the cartilaginous, trough-like bed, being crossed here and there by the cross-bars which serve to stiffen the general framework. In the first two or three arches the clefts do not extend quite to the upper borders. Along the inner edges of these slits the cilia of the pharynx are very long and arranged in rows completely encircling each slit (Fig. 4, Pl. 1), so that by their action they intercept the food particles which are brought into the canal and which might pass through the slits and drive them onward towards the stomach, but allow

the greater portion of the water, in which the food is brought into the canal, to escape into the branchium and be forced, by the contraction of the walls of this cavity, out through the branchiopore once more into the surrounding medium. The *œsophagus* is a short narrow portion of the canal, and leads from the pharynx directly into the *stomach*, which enlarges considerably in diameter, and extends straight back to the end of the branchium. Its walls are rather thicker than those of the other portions of the canal, and upon the inside the cilia are disposed in such a manner that when in motion they force the particles of food, which come into the receptacle, into a long rope-like body, and then cause this food-rope to revolve and twist about until all the nutriment and shape is twisted out of the component particles and the refuse material is forced on into the intestine. The food consists of diatoms, algæ and most any bit of organic material, plant or animal, which is floating in the water in the neighborhood of the animals, and which can succeed in passing the guards and entering the stomach, and if a young animal is taken and placed in some water under the microscope, the entrance of these particles into the canal and their gradual grinding up as they get into this vortex of the stomach, can be readily seen through the nearly transparent tissue, and well repays a little time spent in such observations. Ordinarily these little bits—animals or plants—sail along down the canal without any hindrance from the guards, and as they approach the end of the "rope," they commence rotating slowly about the sides, often, in the case of animals, making uncertain efforts to escape, until after rolling around for a time they are gradually pressed into the mass and twisted on to make room for the others which are continually floating in from the outside. Sometimes a long piece of an alga, or partially dècayed bit of organic material, is drawn by the powerful action of the cilia, with a quick rush, against the mouth orifice or into the mouth cavity; then, with a motion which seems nearly instantaneous, the pharyngeal tentacles are brought forward with a sudden flap, the mouth aperture is widely distended, and the offending substance is thrown out of the body together with the water which was in the mouth cavity, after which the tentacles return to their normal position along the sides of the pharynx. This action is often repeated four or five times before the object is gotten rid of, as the action of the cilia tends to

draw the substance back again immediately into the mouth, and at times, after all this labor to get rid of a substance, it finally succeeds in eluding the tentacles, which flag in their activity after a few efforts, and passes on down the canal. From the lower anterior portion of the stomach there is given off a long, slender saccular diverticulum which extends forward along the lower portion of the right side of the pharynx to about the middle of this part of the body, where it is attached by one or two bands to the bars of the branchial arches, and perhaps to the side muscles, Fig. 3, Pl. 1. This organ is considered to represent the liver. It is of a dark-green or brown color, which is probably due to pigment cells in its walls. The walls of the stomach are also colored, but not so deeply as those of this saccular liver. All this portion of the alimentary canal, including the pharynx, œsophagus and stomach, is covered with a delicate membrane which is reflected from the inside of the abdominal walls, and forms along the roof of the branchium, on either side of the canal, a true pleuro-peritoneal cavity, or schizocœle, which extends back quite to the end of the digestive tract. The *intestine* forms the posterior portion of the alimentary canal, and passes in a perfectly direct course from the stomach to the hind end of the body. It is much smaller than any other portion of the canal, and is of uniform diameter except at the posterior extremity where it enlarges to form the funnel-shaped outlet of the anus. It is not known at present time whether the cilia along the course of the alimentary canal are continuously at work drawing in food, or whether they have periods of rest during which they are perfectly quiet. I have never seen them quiet except upon small patches and in weak animals, and then not for any great length of time, but the fact that the stomach and intestine are very frequently found devoid of food, or of all but a small amount of excrement, would seem to indicate that these animals are not always feeding, and this would imply that they can control, in some manner, the action of the cilia. This would accord well with their habits, and would corroborate to a certain extent the statement already made, that they probably have feeding periods, during which they appear at or near the surface, and resting spells, when they hide from sight.

[*To be concluded.*]

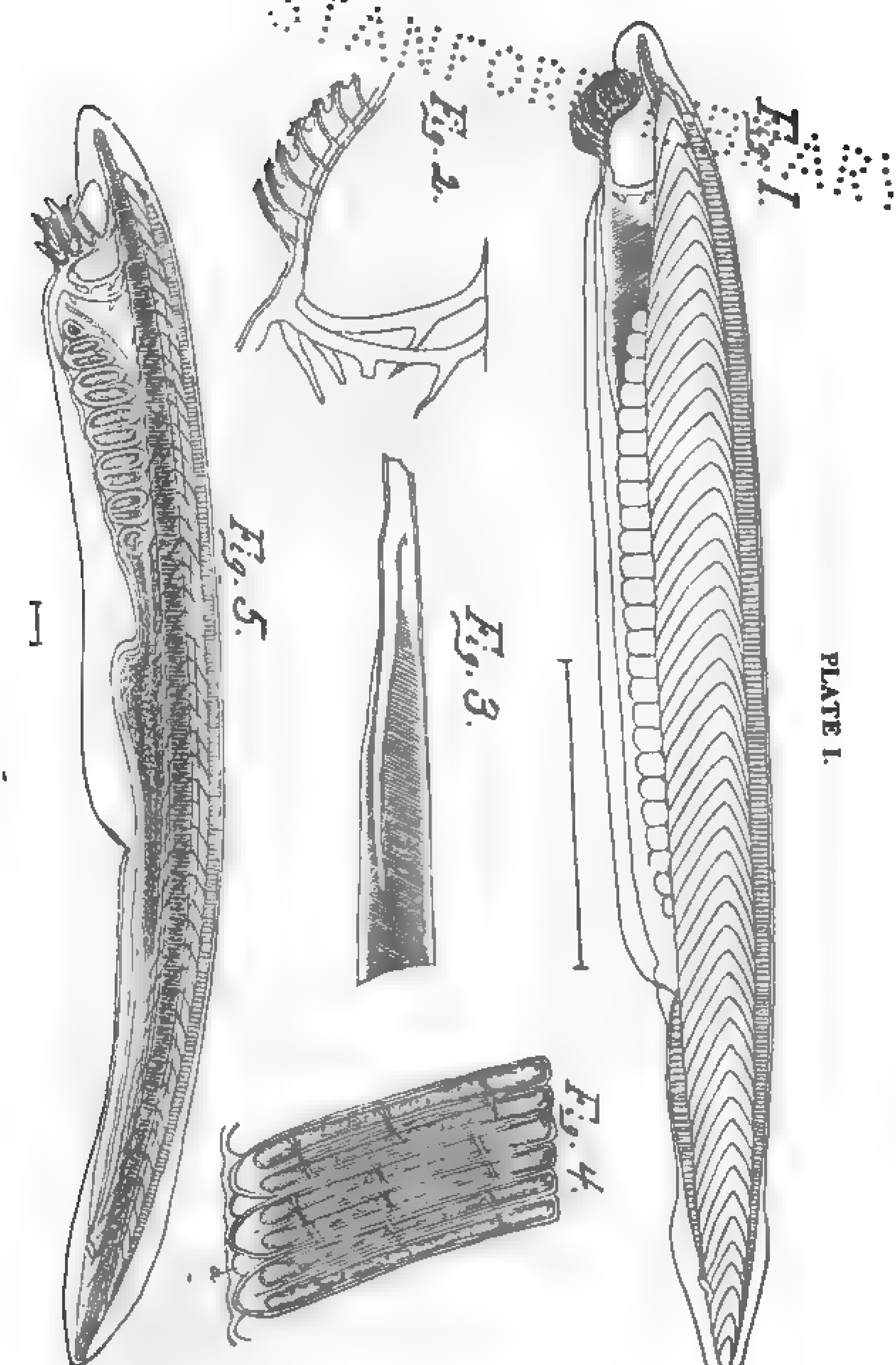
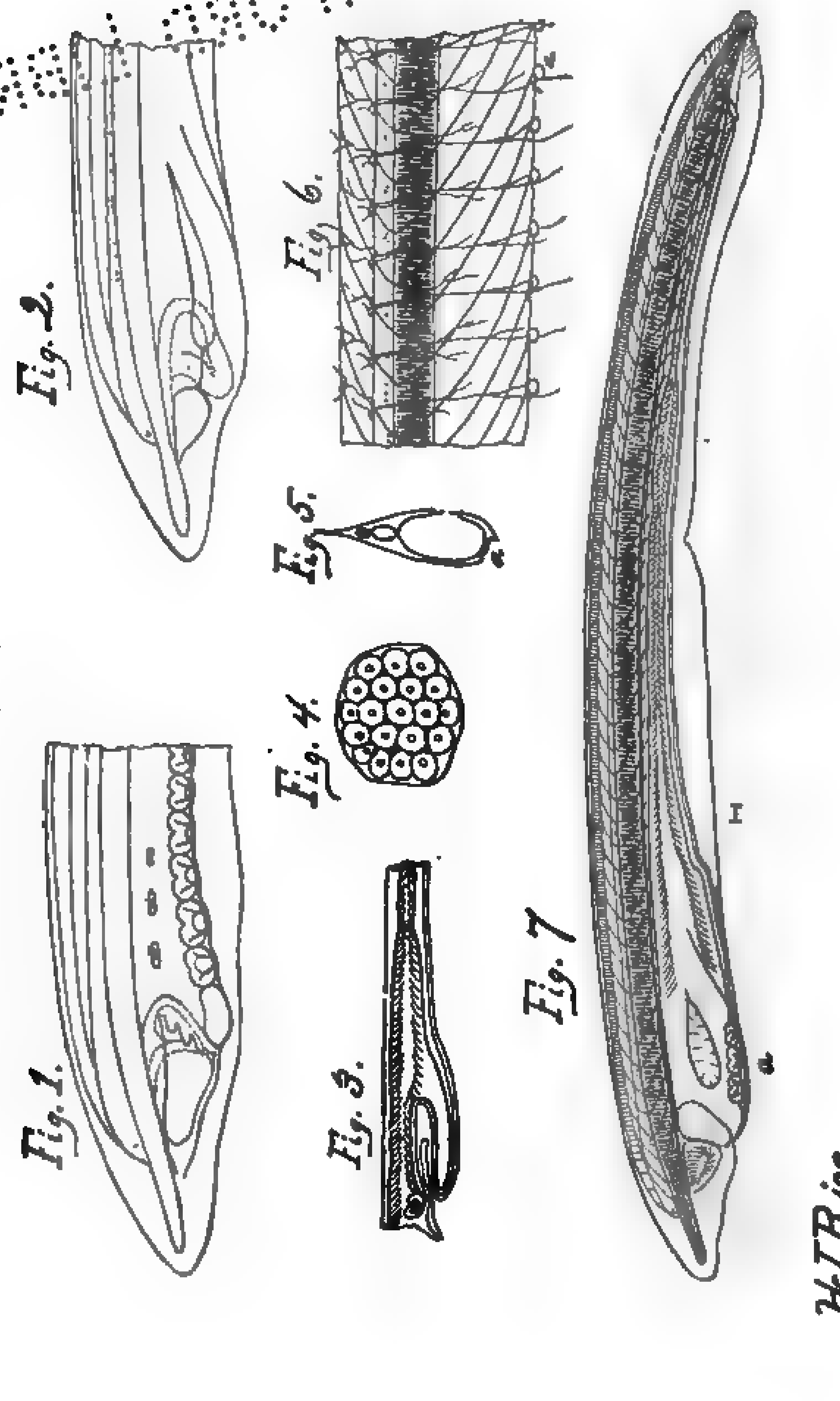


PLATE I.

H. J. Rice,

RICE ON AMPHIOXUS.

PLATE II.



RICE ON AMPHIOXUS.

EXPLANATION OF PLATE I.

The full length figures were drawn either from careful measurement of the parts of the animals, or with the assistance of a camera, so that the outlines may be considered as very nearly, if not quite, correct. Under each of these figures is a line representing the length of the individual.

FIG. 1.—Adult female, $1\frac{7}{16}$ths inches in length, seen from the left side. The egg-cases are represented as squarish blocks attached beneath the body-muscles within the limits of the branchium, which is almost fully expanded. The branchial clefts are shown as oblique lines crossing the anterior portion of the pharynx. In this figure the anal opening is represented about $\frac{1}{32}$ of an inch too far back, and, for want of space to make the lines clear and distinct throughout their entire length, the full number of muscle-plates at the ends of the body have not been indicated.

FIG. 2.—The cartilaginous pharyngeal ring with its tentacles and a portion of the branches of the mouth ring. The mouth ring shows the divisions of the branches into segments and the basal portion of the tentacular prolongations.

FIG. 3.—View of the right side of a portion of the pharynx, showing the extent and position of the saccular liver and the slender branches or bands which attach it to the bars of the branchial arches.

FIG. 4.—Three of the branchial arches of the left side, showing the central bars with their central division lines; the extent of the clefts in the length of each arch; the cilia lining the clefts; the triangular spaces, *a*, between the bases of the arches in which are formed the "branchial hearts" of the blood system, and the cross-bars, running from one side of the arches to the other, and acting as stiffeners to the cartilaginous framework.

FIG. 5.—Young animal, $\frac{3}{32}$ds of an inch in length. The mouth aperture is an eccentric opening upon the left side and partially surrounded by the forming tentacles. The branchial arches are large and prominent, and seven in number, and the liver cæcum is just forming from the central portion of the alimentary canal.

EXPLANATION OF PLATE II.

FIG. 1.—Left side of the anterior portion of the body of a young Amphioxus, showing the first six pharyngeal openings, the first three openings for the left branchial arches, and the mouth-cavity as it appears shortly after the oleft from the pharyngeal mouth aperture to the ciliated pit has closed. The peculiar shape of the anterior pharyngeal openings is caused by their position upon the right side of the median line of the pharynx.

FIG. 2.—An earlier stage of the same portion of the body shown in Fig. 1. Here the pharyngeal mouth aperture, the ciliated mouth cavity, and the cleft connecting the two are plainly indicated.

FIG. 3.—Portion of the alimentary canal of a young animal including the last branchial opening upon the left side of the pharynx, and the entire stomach cavity, and showing the forming liver diverticulum with the ventral blood vessel conforming to its lower border.

FIG. 4.—An egg capsule with its quota of ova, very much enlarged.

FIG. 5.—Diagrammatic cross-section of the body of a young Amphioxus. Section made through the pharyngeal mouth aperture and one of the pharyngeal clefts, as at *a*, Fig. 7, to show the connection of these openings with the central canal. The point upon the body wall or mouth welt, just to the right of the letter *a* in the figure, ought to be more sharply defined to represent one of the tooth-like processes of the mouth welt.

FIG. 6.—View of a portion of the muscular system of the left side of the body of an adult, showing the disk-like character of the notochord; the muscle-plates of the side muscles; the distribution of the nerves of the side, and the attachment and form of the generative bodies, *a*, at ordinary seasons.

FIG. 7.—Young animal, $\frac{5}{81}$ths of an inch in length, showing pharyngeal mouth opening with teeth; cartilaginous pear-shaped welt; ciliated pit, and the first three pharyngeal openings.

SKETCH OF NORTH AMERICAN ORNITHOLOGY IN 1879.

BY DR. ELLIOTT COUES, U.S.A.

SINCE the year 1858, memorable in our annals for the appearance of Baird's great work, which gave such an impetus to the study of birds in this country, and in the light of which a generation of ornithologists has grown up, activity in this department has been incessant; and the workers in this field have never been more numerous or more in earnest than during the year just passed—one which, though marked in no especial manner, has witnessed a steady advance in the extent and in the precision of our ornithological knowledge.

Foremost among the signs of the times stands the *Bulletin of the Nuttall Ornithological Club*, the fourth volume of which closed with 1879. Originating in the necessity which the Club experienced to have a medium of communication with the public, and edited by Mr. Allen with conspicuous ability, this periodical soon secured firm foothold, and its success became assured. The magazine, devoted entirely to the technic of a branch of science, is phenomenal in the fact, that so special a publication has paid for itself from the start, and already doubled its size. It is a trite saying, though generally an untrue one, that such and such a publication "fills a real want," but this is actually the case here. Nearly all the working ornithologists of America record the progress of their affairs in the "Nuttall," so that if one wishes to know what has been found out since the appearance of the last formal treatise on our birds, he turns to the *Bulletin* with confidence. In fine, it answers in America to the English *Ibis* and the German *Journal für Ornithologie*. It is, of course, impracticable to give here any analysis of its contents, and to mention a few leading papers would be both invidious and unnecessary.

It may not be so generally known that there is published at Utica, N. Y., by S. L. Willard, a bi-monthly periodical entitled *The Oölogist*, devoted entirely to the nests, eggs and breeding habits of our birds. Beginning very modestly, *The Oölogist* has more than held its own; several volumes are completed, the size has been enlarged, and the conduct of the periodical has become so workmanlike that the claims of this serial to general recognition are just.

In the same connection we should not fail to notice the

increasing attention paid to ornithology by several of the semi-scientific papers, notably Charles Hallock's *Forest and Stream*, of New York, and Dr. Rowe's *The Field*, of Chicago. Though of course dealing chiefly in game birds, the natural history department of these papers gives us a good deal of ornithological matter; the articles are grown more shapely, with a smaller proportion of untitled, anonymous or otherwise "scrappy" pieces; on the whole, these contributions rank with those of the London *Field*, and many of them are precisely of the character of the shorter notes in the *Nuttall Bulletin*, or in Harting's *Zoölogist*. In the case of *Forest and Stream*, we believe the commendable state of affairs to be largely due to the zeal and competence of Mr. George B. Grinnell, whose example in this particular is to be emulated.

Science News, a fortnightly record of progress in science, established and edited in New York by W. C. Wykoff and Ernest Ingersoll, contains a fair proportion of ornithological matter. Among articles of 1879 may be noted Ingersoll's instructions for forming collections of nests and eggs, and a part of G. B. Sennett's experiences on the Rio Grande. We regret to learn that the publication died with the year.

The promptly-appearing and readily-available avenues of communication thus far mentioned have naturally absorbed most of the current items of ornithological information or entertainment for the year, less than formerly falling to the share of the AMERICAN NATURALIST, and the slower or more irregular publications of scientific societies containing but few papers, all of a very technical character.

Leading these last comes the *Proceedings of the U. S. National Museum*, published by the Department of the Interior under the direction of the Smithsonian Institution. The completed first volume dates 1879, about half of it appearing in sheets in 1878. Here are found the complete results of Mr. F. A. Ober's Explorations in the Lesser Antilles, elaborated in a series of important papers by Mr. G. N. Lawrence. One paper on these collections was in *Forest and Stream*, and descriptions of several of Ober's new species are given in the *Annals of the New York Academy of Science*, but the whole matter is finally set forth in the publication in mention. The *Proceedings* also contain several important papers by R. Ridgway, on neotropical birds, describing new species, monographing the genus *Tyrannus*, &c.,

together with L. Belding's extended list of Californian birds, edited by Mr. Ridgway. Vol. II opens with a paper by Dr. T. M. Brewer on *Empidonax*.

The *Bulletin of the U. S. Geological Survey* gives us its fifth and, as we particularly regret to add, its final volume this year. It consists of the usual four numbers, of which the first and second and third have appeared, the fourth being still in press, delayed by printing E. Coues's protracted and tedious bibliographical matter. In this volume are several papers on birds. Dr. C. E. McChesney, U. S. A., has some valuable notes on the Birds of Fort Sisseton, Dakota. Mr. George B. Sennett gives an extensive and important paper on the results of his second season's operations in Texas, adding several new species to our fauna, with great store of information respecting the habits of the birds of the Rio Grande. Dr. Morris Gibbs gives an annotated list of the birds of Michigan. Dr. Coues prints an article on the present status of *Passer domesticus* in America, including an historical résumé of the quarrel over the sparrow, which has set the brethren of Boston and Washington so by the ears. The same writer also offers a second instalment of his ornithological bibliography, similar in scope and plan to that which forms the appendix to his "Birds of the Colorado Valley," but relating to neotropical instead of nearctic birds.

In the *Proceedings of the Boston Society of Natural History*, Dr. T. M. Brewer gives additional notes on the birds of New England, and Mr. E. A. Mearns has published in the *Bulletin of the Essex Institute*, several instalments of an elaborate and valuable list of the birds of the Hudson Highlands, N. Y.

The *Transactions of the Illinois Horticultural Society*, for 1878, published in 1879, contain a paper on economic ornithology, by Prof. Forbes; and we may add that previous volumes of the same publication contain similar matter, perhaps none too well known. It is an important practical subject; such contributions to which as those of Prof. Forbes, of Prof. Aughey (in the First Annual Report of the U. S. Entomological Commission, 1878), of Dr. J. M. Wheaton (Twenty-ninth Report Ohio Board of Agriculture, 1875), merit special attention pending the sparrow question.

The *Journal of Science*, edited at Toledo, Ohio, by Dr. E. H. Fitch, continues to give popular articles on birds, mostly by the editor, and usually illustrated.

The *Familiar Science and Fanciers' Journal* continues to fill its

chosen sphere well, and has frequent articles of more technical character. Dr. Wm. Wood has here continued his "Birds of Connecticut."

The most important — we had almost said the only very important—contribution to systematic ornithology, among special treatises, is Elliot's Synopsis of the *Trochilidæ*, published as one of the Smithsonian *Contributions to Knowledge*. It is a really great work, which bids fair to supersede Gould's Monograph in all that relates to the technic of the subject. As witnessed by the many critical papers which Mr. Elliot has published during the progress of his study of this family of birds, the author has been unwearied in his attention to the subject, and this extensive quarto gives his final results. Mr. Elliot is "conservative" to a degree; very many nominal species are reduced to synonyms, the preparation of the lists of which shows great care and judgment; and the ridiculously over-large number of genera which various writers have sought to establish, have found what we trust will be their final resting place. Numerous illustrations, from Mr. Ridgway's pencil, fitly illustrate the text of a memoir which instantly becomes indispensable to the working Trochilidists and which will undoubtedly carry the weight of the leading authority on the subject.

Since Audubon's pencil and brush fell from the hand which for so many years turned them to works of unsurpassed beauty, nothing in the way of ornithological art appeared in this country to challenge comparison with the work of the great master until, from an unexpected quarter, the "Illustrations of the Nests and Eggs of the Birds of Ohio" were laid before us by the Misses Jones and Shulze, of Circleville, Ohio. Two numbers of this splendid work have appeared during the past year, and the prospect of the completion of the undertaking brightens as the merits of the "Illustrations" become better known, notwithstanding the untimely death of the leading author on the threshold of her enterprise. This work is in folio, and is published by subscription, in parts, each to contain several colored plates of nests and eggs, of life size, with sheets of descriptive letter press. Combining as it does, the merits of fidelity to nature with artistic excellence, this work commends itself in an especial manner to all those who have a taste for the beauties of bird-life, as well as those who make ornithology a severe study.

Another contribution to our knowledge of the eggs, nests and

breeding-habits of birds is essayed by Mr. Ernest Ingersoll, and so far accomplished in a most meritorious manner. Three numbers have appeared during the year past, in March, August and October respectively. This work is in large octavo, with several colored plates of eggs to each number, and more or less extended biographies of the species. Excepting in certain particulars, which we have noted in other places already, the mechanical execution does great credit to the publisher, Mr. Cassino; and the completion of this extensive work in the manner in which Mr. Ingersoll has begun it cannot fail to enrich the literature of the subject.

We are glad to see the steady progress made by Mr. C. J. Maynard in his meritorious and laborious undertaking, which, beginning as the "Birds of Florida," has been remodeled and enlarged in scope, to represent a history of the birds of Eastern North America. Mr. Maynard is a practical ornithologist of large field experience; his biographies have the unusual merit of originality and make interesting reading, while the attention he pays to the anatomical structure of birds gives prominence to one aspect of the subject much neglected in this country. The work is in quarto, with colored plates; it is published in parts, about a dozen of which have appeared, and deserves to succeed.

With due deference to Herbert, whom, as "Frank Forester," the disciples of St. Hubert seem to have canonized as only a lesser than their patron saint himself, we may refer to Dr. Lewis's work on American Field Sports as one of the most agreeable and reliable of books of this kind, and one a new edition of which has appeared this year.

The veteran taxidermist, collector and dealer of Philadelphia, Mr. John Krider, has also contributed to such literature in the publication of his experiences of "Forty Years."

"Wilsoniana" bids fair to become scarcely less extensive and fertile a field than "Waltoniana" has long been. The appearance not long since of A. B. Grosart's two portly volumes on Wilson's life, character and writings, both prose and poetry, and rather miscellaneous than ornithological, freshened the theme. It may not be generally known that the "father of American ornithology" was anything (and almost everything) but an ornithologist, until the decade before his untimely death in his prime, when his genius at last found its "place in nature," and achieved immortality. Every scrap of paper relating to the "melancholy poet-naturalist" has been eagerly sought for by his

successive biographers, and Grosart, his latest and most enthusiastic admirer, seemed to have told us all we were likely to learn of the man. It was, therefore, with peculiar pleasure that the present writer acquired, from Miss Malvina Lawson, daughter of Wilson's famous engraver, an autograph letter of Wilson's, which was found, on comparison with the documents in Ord's "Life," and in Grosart, to have never been published correctly, or in full. It is that one which, dated Pittsburgh, February 22, 1810, gives an account of Wilson's boat voyage down the Ohio. It is printed verbatim, along with certain letters of George Ord's and Prince Bonaparte's, in the *Penn Monthly* for June, 1879. The writer also received, from the same source, an excellent drawing, never published, of the schoolhouse, near Gray's Ferry, where Wilson taught; and which he would make over to any enterprising publisher who would have it properly engraved.

This slight sketch need not be left without allusion to the "sparrow literature" of the year—a curious mass of raw and not over-nice material, which will, nevertheless, be not without its "final cause," if it contributes to the very desirable settlement of the vexed question of the European sparrow in America.

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HISTORICAL SKETCH OF THE SCIENCE OF BOTANY IN NORTH AMERICA FROM 1840 TO 1858.

BY FREDERICK BRENDEL.

[*Continued from p. 771, Vol. XIII, American Naturalist.*]

AT the time when Torrey and Gray commenced their first work on the Flora of our continent north of Mexico, Sir William Jackson Hooker, the celebrated English botanist, had finished his great work on the Flora of British America, two volumes, in quarto, with 238 plates, London, 1833-1840. But, before we proceed farther, we have to review the early history of botany in the most northern and Arctic regions of North America.

Hans Egede, a Danish missionary, was, from 1721 to 1736, in Greenland. After his return to Denmark, he published, in 1741 a description of that country. He describes, vaguely, some plants, with some drawings on one plate, but it is rather difficult to make out what the drawings mean. Afterwards his son, P. Egede, made some botanical collections, which, as well as those of Gieseke, who published a Flora Grœnlandica, 1816, in Brewste' Edinburg Encyclopædia, and those of Wormskiold, are prese in the herbaria of Hornemann and M. Vahl.

Some Greenland plants were described, 1770, by Rottboell, professor in Copenhagen, and, in the same year a history of Greenland was published by the missionary Cranz; the plants in it were described by Schreber.

The largest collections were made in this century by Jens Vahl, the librarian of the botanical garden in Copenhagen, who traveled nine years in Greenland, and probably there will not many new discoveries be made. J. Lange's catalogue of Greenland plants (in Rink's work on Greenland, 1857), contains 320 species in 52 orders.

A list of plants collected on the coast of Baffin's bay was published by Robert Brown, in 1819, and by the same a "Chloris Melvilleana," 1823, containing 131 species, of which 80 are phenogamous, collected at different times by Sabine, Edwards, Ross, Parry, Fisher and Beverley.

Scoresby's collection in East Greenland, was described by Hooker in 1823, and that of Sabine in 1824.

John Richardson, born in Scotland, 1787 (died 1865), was the naturalist of the expedition from the shores of Hudson's bay to the Polar sea, 1823, under the command of Franklin. This expedition started from York Factory, on Hudson's bay, and proceeded via Cumberland House, Carlton House, Fort Chippeway, on the Athabaska lake, Fort Providence, on the Slave lake, and Fort Enterprise, 65° N. latitude, to the Coppermine river, then along the coast eastward to Cape Turnagain, the Hood river up to Fort Enterprise, to Norway House, on the Winnipeg lake, and back to York Factory. The collection of plants contained 700 species, and was published by Richardson in the botanical appendix to Franklin's Narrative, printed 1823.

The narrative of the discoveries on the north coast of America, by Simpson and Dease, in 1837, published in 1843, contains a catalogue of plants examined by Sir William Hooker, but nothing new; all the species were already collected by Richardson.

Berthold Seemann (born in Hanover, 1825), the naturalist on board of H. M. S. *Herald*, under the command of Captain H. Kellet, during the years 1845-1851, described, in a letter addressed to Sir William Hooker (in Journal of Botany), the arctic Flora of Kotzebue Sound, and published, 1852-1857, the botany of the expedition, the first part of which contains the Flora of Western Esquimaux land.

Bachelot de la Pyiaie, a French botanist, explored, in 1819 and

1820, Newfoundland and the little islands of Miquelon and St. Pierre. He published, 1829, Flore de l'isle de Terre Neuve, which was not finished, and contains only a description of cryptogamous plants.

A Flora of Labrador was compiled by E. Meyer, professor of botany in Kœnigsberg, in 1830, from a small collection by the missionary Herzberg, and a number of species made known by Schrank, professor of botany in Munich. These plants were collected by a Danish missionary, Kohlmeister, probably the same that Pursh calls Colmaster in his Flora, and the plants of which he found in the herbaria of Dickson and Banks. The number of all the species of Labrador known at that time, was 198, of which 30 are cryptogamous.

The north-west coast was visited, 1838, by the expedition of H. M. S. *Sulphur*, under the command of Sir Edward Belcher. This expedition explored the Pacific during the years 1836-1842. The botanist was Mr. Barclay, in the service of the Kew garden, assisted by the surgeon Hinds and Dr. Sinclair. The parts visited were Prince William's sound, Port Mulgrave, both under 60° N. L., Sitka, Nutka sound, San Francisco, Sacramento river and Monterey in California. The botanical collections were described by George Bentham, in " Botany of the voyage of H. M. S. *Sulphur*," 1844, with 60 plates.

The U. S. Naval exploring expedition, under the command of Charles Wilkes, which crossed the Pacific during the years 1838 to 1842, in every direction, arrived, 1841, in Oregon. Charles Pickering was collector on this expedition. The Columbia river up to Walla Walla, and the Willamette valley were examined: afterwards the Sacramento river down to San Francisco. In Oregon were collected 1218 species, and 519 in Northern California; the whole collection of this expedition amounting to 9600 species, were examined. The phanerogamous plants were described by Dr. Torrey; the ferns of the expedition, by Dr. Brackenridge; the mosses by Mr. Sullivant; and the lower cryptogams by other botanists.

N. J. Andersson, a Swedish botanist, naturalist of the voyage around the world of the Swedish frigate *Eugenie*, collected in 1852, in California; he took particular notice of the willows, and in 1858, he published in Proceedings of American Academy of Arts and Sciences, a "Synopsis of North American Willows," of which he

enumerates fifty-nine species, a number of which he degraded to the rank of sub-species in his Monographia Salicum, 1863. He is the author of the genus Salix in Decandolle's Prodromus.

Besides the Rocky mountains and California, another large field opened for exact exploration. The Mexican war and the acquisition of new territories caused a long series of expeditions to California and those tracts of land which form with West Texas the North Mexican botanical province.

In June, 1842, Lieut. Fremont set out from the mouth of the Kansas river, followed that river about one hundred miles, passed over to the Platte river, traveled up the river to the junction of the north and south fork, where the party divided, one part following the north fork to Fort Laramie, the other proceeding along the south fork to Fort St. Vrain, and from there to Fort Laramie. Then the expedition followed the north fork and the Sweetwater river up to South Pass, and the Wind River mountains, the highest peak of which, afterwards called Fremont's Peak, he ascended. Returning, the Platte river was followed to its mouth. The collection of plants, consisting of 352 species, contained fifteen new ones; described by Torrey.

The collections of Fremont's second expedition, during the years 1843 and 1844, which extended to Oregon and California, were greatly damaged, so that in many instances it was extremely difficult to determine the plants. Torrey furnished the description of a few new genera and species, which, with four plates, was published in App. C. to Fremont's Report. One of these new genera he named Fremontia, but this name was afterwards withdrawn, as Nees had already described the plant under the name Sarcobatus, and Fremont's name was transferred to another new Californian genus of the order of Sterculiaceæ.

Two other expeditions were undertaken by Fremont in 1845-1846 and 1848, extending to California. Large collections were made again, but the greater part of them were destroyed by the same mishaps. Some of the new genera that were saved for examination were described and published in 1850, by Professor Torrey in the Smithsonion Contributions, as "Plantæ Fremontianæ," with ten beautiful plates.

Emory's military expedition traversed in June and July, 1846, the plains from Fort Leavenworth to the bend of the Arkansas, followed this river to the Pawnee fork, crossed the Raton moun-

tains (7000 feet) and the ridge between the Canadian river and Rio Grande to Santa Fé; then again the dividing ridge (6000 feet) between the Rio Grande and Gila, followed the latter to the Colorado of the West, and arrived at St. Diego. The botanical collections (about 200 species) were examined by Torrey, the Cactaceæ by Dr. Engelmann, and published in Appendix 2 of Emory's Report. A small number of plants was collected by Lieut. Abert, amongst which was nothing new.

Dr. A. Wislizenus, born in Germany, 1810, left St. Louis in the spring of 1846, with the intention of traveling in North Mexico and Upper California. He undertook the journey at his own expense, and war was not yet declared, when he arrived at Chihuahua; but there he was arrested as a spy, and transported to Cosihuirachi, at which place he was left in a "passive" condition; that means as to his free will to leave; for, as a collector, he was very active on this rich field, where he collected so many species not found before. Six months afterwards, Colonel Doniphan's troops occupied that part of the country, and Wislizenus accepted a situation in the medical department of the American army, and, instead of going westward as he first intended, he followed the army to Monterey, and returned via Matamoras to the States. He collected a large number of plants. In an Appendix to the "Memoir of a tour to North Mexico in 1846 and 1847, by A. Wislizenus, M. D., printed for the use of the Senate of U. S.," the botany of the explored country is described by Dr. Engelmann. Amongst the new species were over thirty new species of Cactus.

West Texas was extensively explored since 1835, when Ferdinand Lindheimer (born in Germany, 1802), settled at New Braunfels, where he lives yet. His large collections were named and described by Gray and Engelmann, in Boston Journal of Natural History, as Plantæ Lindheimerianæ, part I in 1845, part II in 1847. Many of these plants were shortly afterwards described by Scheele, in Linnæa, from a collection brought to Germany by the geologist F. Roemer, who studied the geology of Texas in 1846-1847, and received many specimens from Lindheimer.

Completed and extended to the whole area of the Rio Grande, were these explorations by Gregg and Wright.

Josiah Gregg, the author of the "Commerce of the Prairies, 1844," made large botanical collections, but died in California.

Charles Wright spent several years in Texas, the botany of which country he studied. Then, in 1849, he went westward to El Paso, in New Mexico. His rich collections of plants were placed in the hands of Prof. Gray, who described and published "Plantæ Wrightianæ" in the third volume of Smithsonian Contributions, with ten plates. In 1851–1852, he was again in New Mexico, the collection of which tour furnished the material to the second part of Plantæ Wrightianæ, with four plates, in the fifth volume of the Smithsonian Contributions.

Another well-known botanist explored New Mexico at the same time. August Fendler came, about the year 1836, from Germany to North America. In 1846 he left Fort Leavenworth with a military train, followed the Arkansas river up to Fort Bent, crossed the mountains to Santa Fé, where he made his principal collections from April to August, 1847. An account of his collection Prof. Gray published in the Memoirs of the American Academy, Vol. IV, under the title, Plantæ Fendlerianæ. Fendler resided a long time near St. Louis; went afterwards to Venezuela, and is now collecting on the Island of Trinidad.

Dr. Woodhouse was a member of the expedition down the Zuñi and Colorado rivers under the command of Capt. Sitgreaves, in 1850. His collections, placed for examination in the hands of Prof. Torrey, consist of three portions: the first, collected between Neosho and Arkansas rivers, and on the north fork of the Canadian, and the second, from Texas, contain nothing new. The plants of the third portion were collected in Arizona and California. The catalogue of the latter (about 180 species) is published with twenty-one plates, in 1853, with Sitgreaves' Report. There is described a new genus of the order of Amarantaceæ and several new species.

In the year 1852 an expedition under the command of Capt. Marcy explored the Red river to its sources. The botanical collection of 200 species, made by Dr. Shumard, was examined by Prof. Torrey. and published in App. G of Marcy's Report with twenty plates.

The botany of these formerly Mexican provinces was nearly unknown before Berlandier; but by the collections of the above-named botanists much light was thrown upon it; their work was further advanced by the Pacific railroad explorations and the Mexican boundary survey, and will be completed by the surveys of the

Territories in progress yet. Here may be mentioned, though not in the compass of this historical sketch, the surveys of Hayden, Powell, Wheeler, and King, who surveyed the State of Nevada, and whose report contains, in the fifth volume, the botany of Nevada and Utah, by Sereno Watson.

Several expeditions were ordered by the Government, in 1853, to cross the Rocky mountains to the Pacific, along certain parallels, to explore the most practical route for a railroad to the Pacific coast. The parties consisted of a military command and a number of technic and scientific assistants. The reports of these explorers were afterwards published by the Government in thirteen quarto volumes, extensively illustrated and full of the most important scientific matter. The botanical collectors were the following: Dr. Suckley, naturalist to the party of Gov. Stevens, who proceeded between the parallels 47 and 49 to Oregon. The botanical report of this route, with six plates, we find in the last volume; it contains the collections of Suckley on the plains, 323 species, examined by Prof. Gray (one genus and three species were new), and a catalogue of plants from Washington territory collected by Dr. Cooper. Those east of the Cascade range, 75 species, of which two were new, were examined by Prof. Gray, those of the west side, 386 species, of which one was new, collected by Suckley and Gibbs, were examined by Torrey and Gray. A general report on the botany of the route is written by Dr. Cooper.

In Vol. II, Torrey and Gray reported on the collection of plants made by F. Creutzfeldt, a German gardener from St. Louis, who was engaged as botanist under the command of Capt. Gunnison, and was killed with the same, by the Indians, near Sevier lake, Utah. He collected 124 species, with two new ones; the report is illustrated by three plates. After the murder of Gunnison, the party reached, under Lieut. Beckwith, the Great Salt lake, where the winter was passed. J. A. Snyder, the topographer of the party, took charge of the botanical collections made along the 41st parallel, from the Great Salt lake to the Sacramento river. The plants, 59 species, were published by Torrey and Gray. There were seven new species, illustrated on seven plates.

The richest collection was that of Dr. J. M. Bigelow, under Capt. Whipple, along the 35th parallel; it is published in Vol. IV, and contains 1109 species of vascular plants, amongst which nine

genera and seventy-two species were new, illustrated by twenty-five plates. In a separate report Dr. Engelmann described fifty Cactaceæ, of which eighteen were new and illustrated by twenty-four plates, and Sullivant seventy-two mosses, with twelve new ones and ten plates. Very instructive is the general description of the soil, of the productions along the route, and the forest trees by Bigelow.

The route near the 32d parallel, from El Paso to Preston on the Red river, was explored by Capt. Pope. Dr. Diffendorfer made the botanical collections, which contained 268 species, of which three genera and thirteen species were new. The catalogue is published by Torrey and Gray in Vol. II of the Reports, with ten plates.

Dr. A. L. Heermann was the naturalist under the command of Lieut. Williamson, who explored the passes in the Sierra Nevada and the coast range. The catalogue of eighty-eight species, amongst which were fourteen new ones, with eighteen plates, described by Durand and Hilgard, we find in Vol. v, with a separate collection of the geologist, W. P. Blake, containing eighty-seven species, with six new ones and ten plates, described by Dr. Torrey.

Vol. VI contains the interesting botanical report of Dr. J. S. Newberry, geologist under the command of Lieut. Williamson when he explored the country between the Columbia river and Sacramento river. Besides an article on geographical botany, he described the forest trees with ten plates, and added a catalogue of 531 vascular plants (two genera and eight species were new) with six plates, twenty mosses and ten lichens. He was afterwards a member of the expedition on the Colorado of the West, under the command of Lieut. Ives, in 1857–1858. The report was published in 1861, and part 4 contains the catalogue of plants examined by Gray, Torrey, Engelmann and Thurber, 400 species with ten new ones.

Dr. Thomas Antisell collected, under the command of Lieut. J. G. Parke, between the Rio Grande and Southern California, 281 species (one genus and three species were new), which are published with eight plates in Vol. VII of the reports.

The Mexican boundary survey began in 1849, and continued with an interruption, and after a reorganization under Major Emory in 1853, till 1856. The report of Emory was published,

1858, in two large volumes; the first half of the second volume contains the botany. An introductory chapter on geographical distribution and botanical features of the country was written by Dr. C. C. Parry, the catalogue of plants, with descriptions of twelve new genera and 195 new species, with illustrations on sixty-one plates, by Torrey, partly by Gray and Engelmann, who elaborated the Cactaceæ separately and described ninety-two species, of which not less than forty were new, with seventy-five plates. The whole work contains under 2140 species, 235 new ones. The most new species, besides the Cactaceæ, we find amongst the Euphorbiaceæ (36), described by Engelmann, then under the Compositæ (32), and the Scrophulariaceæ (19), both orders described by Prof. Gray. Eight orders comprise half the species of the collection: Compositæ 430, Leguminosæ 212, Euphorbiaceæ 101, Cactaceæ 92, Scrophulariaceæ 71, Cyperaceæ 61, Labiatæ 53 and Cruciferæ 47. The large order of Gramineæ, elaborated by Dr. George Thurber, was unfortunately omitted on account of the already too great size of the volume. Geo. Thurber was one of the botanists of the survey under Bartlett at the same time with Dr. J. M. Bigelow. Gray published already, in 1854, in Memoirs of the American Academy of Arts and Sciences, N. S. Vol. v, "Plantæ novæ Thurberianæ," twenty-eight species, of which six belong to six new genera. Charles Wright was attached by Col. Graham to his separate corps of the survey. Under Emory, Dr. C. C. Parry and A. Schott made the botanical collections.

The important result of all these explorations was not only the multitude of new genera and species made known, but the light thrown upon the distribution of North American plants. It was recognized that there is an unmistakable difference between the eastern wooded, the central treeless and the Californian sections of temperate North America, of which the first may be called the sylvan, the second, the campestrian, and the third, the Californian botanical province. The campestrian province reaches from West Texas to Southern California, and far north on both sides of the Rocky mountains; the Sierra Nevada and Cascade range, in Oregon, form the western border, but on the east side there is no sharp line, the prairies stretching into the wooded country. That the flora of East Texas is identical with that of Louisiana and the other Gulf States, Engelmann has suffi-

ciently demonstrated in the Proceedings of the American Association, fifth meeting, 1851.

At the time of Fremont's first expedition, two German botanists directed their lonely ways to the Rocky mountains and to the Territory of Oregon.

Carl Geyer, born 1809, came to America in 1835. As already mentioned he was employed as a collector by Nicollet, afterwards he crossed the Rocky mountains under 40° N. L. to Oregon territory. His rich collections were sent to Sir William Hooker, who examined the plants and described fourteen new species in *Journal of Botany*, 1845 to 1856. Geyer himself furnished interesting remarks on the features of the country. He returned in 1845 to Germany, and died there in 1853.

Lueders, from Hamburg, crossed the Rocky mountains in 1843, and made collections in Oregon Territory. Fremont met him near the Cascades of the Columbia river, where he (Lueders) lost his package by capsizing of his canoe in the rapids, an accident which Fremont memorized by naming a little bay in that locality after his name Lueders' bay, probably a poor reparation for his loss. Nothing was known of him afterward.

Descriptions of plants collected by Dr. Wm. Gambel in the Rocky mountains and California were published by Thomas Nuttall in the Proceedings of the Academy of Natural Sciences of Philadelphia, in 1848. He proposed twelve new genera and 106 new species, but not all of these remained valid.

Captain Stansbury explored, 1849-1850, the valley of the Great Salt lake. His report was published by the Government in 1852. Appendix D contains the botany examined by Torrey, 114 species, of which three were new and some new varieties, with nine plates.

The knowledge of the botany of British America was greatly promoted by Sir John Richardson's Arctic searching expedition, published in two volumes, London, 1851. The object of the expedition was the search for the lost Captain Franklin along the north coast. The voyage was made in boats from Lake Superior via Lake Winnipeg to the Mackenzie river, then from Great Bear lake to the Coppermine river, and lasted from May, 1848, to Sept. 1849. In the Appendix (more than half the second volume) we find chapters on the physical geography, climatology and geographical distribution of plants north of the 49th parallel, with

most valuable observations. There is a list of trees and shrubs with their northern limits, and a table of the distribution of Carices, which was prepared by Dr. Francis Boott, one of the best authorities and author of the beautiful "Illustrations of the genus Carex," the 4th part of which was after his death published by J. D. Hooker. Boott was born in Boston, 1792, and died in London, 1863.

In the summer of 1848, Prof. Agassiz made a scientific excursion to the Lake Superior with a number of students. He published, 1850, a volume on the physical character, vegetation and animals. Two chapters treat of the botany on the shore of Lake Superior compared with that of the Jura and the Alps. The accounts of such excursions are highly interesting, when related by competent botanists, *e. g.*, that published by Prof. Gray in 1841, in *Silliman's Journal*, "Notes of a Botanical Excursion to the Mountains of North Carolina."

The most prominent American botanists of our times are Torrey, Gray and Engelmann.

John Torrey was born in New York, 1798, and died on the 10th of March, 1873. Author of many botanical writings, he published, as early as 1819, a "Catalogue of plants growing spontaneously within thirty miles of the city of New York;" in 1824 a "Flora of the northern and middle sections of U. S.," of which only Vol. I was printed, containing Classes I-XII of the Linnæan system, which was at that time yet in general use; 1826, a "Compendium of the Flora of the Northern and Middle States;" 1836, a "Monograph of the North American Cyperaceæ" (in Annals of the Lyceum of New York, Vol. III); from 1838 to 1843, with Asa Gray, the first two volumes of the Flora of North America already mentioned. It contains the orders from Ranunculaceæ to Compositæ, and was not continued at that time, but will be finished now, since the large amount of new material brought from the Western explorations is nearly worked up. In 1843 appeared his "Flora of the State of New York," two large quarto volumes, with 162 tables, forming the second part of the Natural History of New York. In the preface we find a historical sketch of the botanists and their work in the State before that time. His other writings are already mentioned.

Asa Gray was born on the 18th of November, 1810, in Oneida county, New York, and is now Professor of B

Harvard University, at Cambridge, Mass. His first work was published 1834-1835, "North American Gramineæ and Cyperaceæ," two volumes, containing each one hundred species, illustrated by dried specimens. It was followed by "Elements of Botany," 1836; "Melanthacearum Americæ septentrionalis revisio," 1837; the "Botanical Textbook," 1842 (third edition, 1850); "Chloris Americana," illustrations of new, rare and otherwise interesting North American plants. Decade I, with ten beautiful plates, 1846 (not continued). The first edition of his well-known "Manual of the Botany of the Northern States," appeared in 1848, and was followed by many editions. "Genera Floræ Americæ boreali-orientalis illustrata, Vol. I and II, with 186 tables," from Ranunculaceæ to Terebinthaceæ, was not continued. Already mentioned are many of his contributions in public documents, Smithsonian publications and scientific periodicals, too numerous to be all named, but all of the greatest value.

George Engelmann, born in 1810, in Frankfurt-on-the-Main, came to America about the year 1834, and has resided since that time in St. Louis, Missouri. Except his writings mentioned above, he has published, in different periodicals, a number of monographs of difficult orders and genera, *e. g.*, Cactaceæ, 1856, Cuscutæ, 1859. His papers on North American Juncus, Quercus, Yucca, some Coniferæ and Gentianæ are later.

Other active botanists of that period are A. Wood, who published a "Classbook of Botany," which is much in use. There is a "Botany of the Northern States," by L. C. Beck, professor in Albany, who lived from 1798 to 1853; a "North American Botany," by Eaton and Wright; an "Introduction to Botany," by Comstock; an "American Flora," by Strong; a "Botany of the Southern States," by Darby.

Local floras and catalogues of plants were compiled, by Dewey: Report on the Herbaceous Plants of Massachusetts, 1840; by Emerson: Report on the Trees and Shrubs of Massachusetts, with seventeen plates, 1846; by Lapham: Plants of Wisconsin, 1849, and a Catalogue of Plants of Illinois, published in the second volume of Trans. of Ill. State Agric. Soc., 1857. Catalogues and notes on the botany of this State were published previously, 1826, by Dr. L. C. Beck, and, 1843, by C. Geyer, with notes by Dr. Engelmann, both in *Silliman's Journal*, then 1845, by Dr. C. W. Short in the *Western Journal of Medicine*. Much has been done

for the knowledge of the botany of Illinois by Dr. S. B. Mead, of Augusta, Hancock county, and Dr. G. Vasey, of McHenry county.

Amongst the American botanists, although born in Germany, may be named Dr. Rugel. He came, in 1842, to America, and settled afterwards in East Tennessee, where he lately died. He collected in the South-eastern States, and used to send his collections to Shuttleworth, in Geneva (Switzerland).

There is a number of catalogues which fall partly in the latter time of the second period, that of Bachman, of the plants in the vicinity of Charleston, S. C., 1834; by Gibbes, of the plants of Columbia, S. C., 1835; by Aiken, of the plants near Baltimore, 1836; by Lea, of plants collected in the vicinity of Cincinnati, after his death published by Sullivant. The fungi of the collection were examined by Berkeley.

Ravenel published a paper on the plants of the Santee canal, 1850, and Kirtland one on the climate, flora and fauna of the southern shore of Lake Erie, 1852.

Publications on single orders exist of Jos. Barratt, "Salices Americanæ" and "North American Carices," 1840; of Tuckerman, "North American Lichens," 1848; of Sullivant, "Musci Alleghaniensis," 1846, and "Bryology and Hepatology of North America," 1847; of Bailey, on "North American Algæ." 1848; of Curtis, on "North American Fungi," 1848, both in *Silliman's Journal;* of Dewey, "North American Carices," in *Silliman's Journal;* of Sartwell, "Carices Americæ septentrionalis exsiccatæ," 1848–1850 (158 species); of Alex. Braun (professor in Berlin, who died lately), "Equisetæ and Charæ," in *Silliman's Journal;* of Harvey (professor in Dublin, dead since 1866), "The Marine Algæ of North America," in Smithsonian Contributions, 1858, three volumes, with fifty plates.

The chief authority on North American fossil plants is Leo Lesquereux, a native of Switzerland, residing in Columbus, Ohio, who is besides a trustworthy judge of mosses, and compiled the catalogue of Arkansas plants in Owen's Geological Report. An important branch of science, the geographic[illegible] [illegible]ion of American plants, is yet in its infancy. It [illegible] h knowledge of local floras in connection wi[illegible] climatological condition of each locality to [illegible] this matter. Some steps have been made in

preparatory work has been done, but the main labor is left to the future. Prof. Gray published "Statistics of the Flora of the Northern U. S.," in *American Journal of Science and Arts*, 1856, which will promote the cause for that part of the country. Dr. J. G. Cooper published a good article on the distribution of the forests and trees of North America, in Smithsonian Report for 1858. As only the woody plants are here accounted for, the limits drawn cannot be intended as to separate botanical districts in general. Even for the forest plants the limitations admit of some corrections, but as a preliminary essay it is valuable.[1]

Here this sketch must be concluded, for two reasons—1, the newest botanical literature is so extensive, and partly published in so many different periodicals, that a private library is not sufficient for a survey of the whole; 2, the number of botanists has increased so much throughout the country, as is shown by Cassino's Naturalist's Directory, that it is rather difficult to winnow the chaff from the wheat, and to avoid offence by neglecting a man whose merits are worthy of mention.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The Academy of Natural Sciences of Philadelphia, nearly four years since, made a number of changes in its organization as expressed in its by-laws. With but two dissenting voices, the academy concluded to place the direction of the museum, and the scientific work dependent on it, in the hands of thirteen professors, who were to perform the work previously entrusted to four curators. Experience had abundantly shown, what is indeed self-evident, that a general scientific museum cannot be obtained, arranged or controlled by four persons, however gifted; and further, in the history of the institution it had generally been the case that the four curators were not all selected from the original investigators or active scientists of the academy. It was thought

[1] Although published in 1860, yet, as the author has mentioned several works published later than 1850, we may here draw attention to the Flora of the Southern United States, containing abridged descriptions of the Flowering Plants and Ferns of Tennessee, North and South Carolina, Georgia, Alabama, Mississippi and Florida, by A. W. Chapman, M. D. The Ferns, by Daniel C. Eaton, New York, 1860. pp. 621.—EDITORS.

to be important that the control of the working material of the institution should be in the hands of those who do the work and give it its reputation; and further, that lectures should, from time to time, be delivered, which would constitute statements of the progress of science, as made by the workers of the academy and of the world at large. These propositions, whose reasonableness is so self evident, bringing the academy, as they would, into conformity with the usage of similar bodies throughout the world, were stoutly resisted by some of the members. As discussion proceeded, it became evident that without such an organization, or its equivalent, the title of "Academy" is a misnomer, and that nothing good could be expected of the club management under which it was conducted. It was shown that under this order the position of an expert *working in the institution* was an unenviable one; that free use of the museum exposed him to charges of misconduct by irresponsible and ignorant persons, and brought him in conflict with employés who recognized only the authority of the four curators. It was brought to view that the most profuse liberality and generosity to the institution afforded no protection from these wrongs, and that while gifts of the greatest value were gladly accepted, obstacles, often indirect but always effective, were thrown in the way of the use, by the donors, of these, and even of unpresented private property. It was shown that the arrangement and labeling of the collections were frequently entrusted to incompetent persons, and that the result was what might be expected; also that the museum was not keeping pace with the age, and that as a consequence, original work in connection with it had almost ceased. The result of the discussion was as stated, the adoption of the proposed re-organization, with only two dissenting voices.

One of the two noes came from the president, Dr. Ruschenberger. Although standing thus in opposition to the will of the academy, the services of this gentleman in the cause of science in raising money for the erection of the building the academy now occupies, were justly so appreciated by the members, that he was reëlected to fill the position for another year. A due sense of the generous action of the majority in thus electing an opponent to the highest position within their gift, if not sufficient to induce conformity to the republican principle of a support of the views of the majority, should at least have suggested a passive attitude towards their attempts to carry their wishes into effect. But the friends of progress were doomed to disappointment. A determination to stamp out the new measures was manifested by a few members, who, having abandoned legitimate opposition, adopted the weapon of the weak—personal defamation. By introducing damaging personalties, so that a full discussion was impossible prior to an election of officers, much injury to the interests of the institution, as well as injustice to private persons,

was done. The president was, by no means, clear of complicity in these proceedings, which, after the lapse of two years, received the emphatic condemnation of the academy by a vote in the proportion of two and a-half to one. In the meantime the new by-laws not only remained a dead letter, but additional changes were made which completely nullified them. The most important of these, by excluding the prospective professors from the council, rendered the positions untenable by men who value the prosperity of the academy. But this was simply a first step in the development of a new policy of the president's own conception, and for which he should have full credit, as expressed by himself.

Dr. Ruschenberger has stated verbally, that it was his opinion that the council of the academy would be better constituted without the membership of the specialists. He has also maintained, that the prospective professors should not be members of the council, because it is the duty of that body to "direct the professors when to lecture, where to lecture, and what to lecture about." He is credited with saying, that no "high science" can be looked for from such an institution, as it is a kind of high school, etc., etc.

We have here at last the opposition to the new organization crystallized, which we think to be a desirable consummation. Is the "Academy" to be an academy of original research in the sciences, or, shall we say, a trustee school, which will tolerate original research provided it be not too extensive or important? Shall the institution adopt a mediæval system which has been repudiated long since in many countries as regards universities, and which has no relation anywhere to academies of science? Is it necessary to say that an academy of sciences consists exclusively of a body of experts in science, and that under this established definition some of our officers have no claim to even membership in such a body? Are we to return to the days when learned men were the property of priests or the mere ornaments of the governing classes of society, subject to their dictation as to "where they shall lecture, when they shall lecture, and *what they shall lecture about.*" That is what the scheme of Dr. Ruschenberger amounts to, only substitute for priests and nobles a collection of generally worthy gentlemen, who know more of everything else than of science and its needs. That this scheme is in entire antagonism to the intention of the founders, whose object was original research, is sufficiently clear.

In direct opposition to the present domination of such views, and to prevent the perversion of the academy's property to uses not contemplated by its constitution, a resolution to make the prospective professors ex-officio members of council was largely and respectably signed and laid before the council, in hopes of its adoption. Among the signers may be mentioned the names of Leidy, Cope, Ryder, Dercum, Brown and Parker, well known in

Philadelphia scientific work. But the proposition was rejected by a quorum of the council, and the president has issued a report of the proceedings, which now lies before us. As it occupies nearly twelve octavo pages, it of course includes much besides the proceedings referred to, and is in fact a digest of the president's views on the subject. That such a document should be prepared, shows that its author has but a faint conception of the position which he occupies in relation to the opinions of the majority of members of the academy. An examination of its contents shows that his perception of the proprieties of discussion, both as a man and as an officer, is still less clear. We only allude to the gross inuendoes and slurs it contains, to state that some of the worst of them were added by the author after the formal authorization of the publication of the report of council, and that he thus commits an offence against ordinary propriety, and against the Society itself. Such is also the omission of the names of persons against whom some of these charges are leveled, which names were contained in the report as read. We think, however, that the publication will be, on the whole, useful to the academy's cause, as it indicates, in no doubtful way, the unfitness of its author for the position he occupies.

We, however, call attention to one subject, which, dressed up in various guises, has served, and still serves, as a scare-crow to some useful members. The proposition to create thirteen professors who shall be ex-officio members of council, does not disturb the present order, by which the general officers of the academy are ex-officio members of council. It simply places the experts of the institution on an equal footing in council with those elected by the academy at large, thus forming a body composed of what might be called senate and house combined. But Dr. Ruschenberger pretends to be alarmed for the safety of the property when entrusted to the care of the thirteen. We do not believe that any one else is apprehensive of danger, but if they are, we suggest that still greater risks attend the charge of the collections by equal or smaller numbers (say four, as at present) of persons, who are mostly unacquainted with the business. Secondly, the use of new material by thirteen men to the exclusion of the eight hundred and eighty-seven other members of the academy, appears to Dr. Ruschenberger, to be a monstrous injustice. Perhaps the doctor would approve a plan by which all these gentlemen might take turns at describing the mass of new species daily received at the hall of the academy; or the difficulty could be gotten over if the council would resolve that new species might be described several times.

But seriously, the president inverts the order of things absolutely. *The amount of new material coming to the institution obviously depends on the number of persons interested in bringing it there.* If such interested persons find that they have no rights

that any one is bound to respect, they will not bring it there; as is the case at present. And thirteen men who are interested, and who know how to obtain it, will certainly benefit the academy more, than four persons,[1] most of whom do not know new material when they see it, have no use for it, and do not know how to get it.

Finally, we suggest whether the professorship scheme would not go better if a chair of libel were added to the list. The only reason why this chair should not succeed would be, that the most eligible candidate could not then be a member of council, who would have the power to direct him " where to lecture, when to lecture and what to lecture about."

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RECENT LITERATURE.

GEOLOGICAL SURVEY OF CANADA.[2] — Owing to the separate paging for the several reports filling this volume, by which the process of printing has been hastened, it has appeared sooner than its predecessors. It is devoted mainly to interesting observations on the stratigraphy of the Quebec group, by Mr. Selwyn, who seems to discard the names Norian, Montalban, Taconian and Keeweenian, proposed by Dr. Sterry Hunt, and now in quite general use by New England geologists. Mr. G. M. Dawson reports at length on the geology of British Columbia, Mr. S. H. Scudder describing the fossil insects. The reconnaisance by Mr. Robert Bell of the west coast of Hudson's bay, gives us the first definite knowledge, so far as we are aware, of that interesting region. He claims that there is abundant evidence of the elevation of the land (or to use his own words, " that the sea-level is falling ") at a comparatively rapid rate in Hudson's bay. " Since," he writes, " the Hudson's Bay Company's ports have been established at the mouths of the various rivers, there has been an increasing difficulty in approaching them with large craft. On the islands and shores all along the Eastmain coast, the 'raised' beaches are very conspicuous at all heights up to about three hundred feet immediately near the sea, but, no doubt higher ones would be found further inland. Drift-wood (mostly spruce) is found almost everywhere, above the highest tides, in a more and more decayed state the higher above the sea, up to a height of at least thirty feet, and in some places up to forty and fifty feet, above which it has disappeared by the long exposure to the weather. Judging by the rate of decay of spruce wood in this climate, its preservation in large quantities, during an 'elevation' of the land, or rather a fall in the water, to the extent of thirty

[1] This excepts the few cases where private persons or bodies are allowed control of their own collections deposited in the academy building.

[2] *Geological Survey of Canada.* ALFRED R. C. SELWYN, F.R.S., Director. Report of Progress for 1877–'78. Montreal, Dawson Brothers, 1879. 8vo, with maps.

feet, would indicate a change in the relative level of the sea, amounting to perhaps between five and ten feet in a century."

Boulder clays are abundantly developed, containing numerous shells characteristic of the Leda clays of the coast of Labrador. It appears that the white whale still exists in considerable numbers all along the coast, while "the walrus is killed by the Esquimaux, principally about the entrance to Hudson's straits and around the Belcher islands. In former years this animal is reported to have been seen occasionally as far south as Little Whale river. On the opposite side of Hudson's bay walruses are said to have been seen near Cape Henrietta Maria. The narwahl is occasionally killed by the Esquimaux in the northern part of Hudson's bay. In the spring, soon after the shore ice disappears, the polar bear occasionally comes ashore on Long Island and the smaller islands between it and Great Whale river. In the winter they have been known to range as far south as the head of James' bay." The climate of the west coast of Hudson's bay in the Nelson river region is milder than that of the opposite coast, and that of the region about the Norway House is fully as good as that of the Province of Manitoba. The subsoil in places is frozen through the summer, and it is possible that toward York Factory it is permanently frozen.

The volume closes with reports by Messrs. L. W. Bailey and R. W. Ells on the Pre-silurian and Cambrian rocks of Southern New Brunswick, and on the superficial geology of New Brunswick, by Mr. G. F. Matthew; on the geology of Cape Breton, by H. Fletcher, with others on economical geology.

MORSE'S SHELL MOUNDS OF JAPAN.[1]—Not only has Japan an university very fully manned with American, English and German instructors, but her desire to make it a genuine university, by contributing to the advancement of science, is made evident by the publication of a volume giving the results of researches carried on by the professors and students. The first contribution is to the new science of anthropology by a people which has but recently thrown off the habits of a semi-civilized race and adopted the modes and sciences of those which call themselves civilized. This memoir is timely in its issue, for with a tolerable acquaintance with prehistoric archæology in Europe, America and parts of Asia, such as we now possess, comparative studies on the prehistoric remains of a people so old as the Japanese, and with such an interesting geographical position, would prove highly suggestive and of very considerable value. And here it may be observed, parenthetically, that it is claimed by the author, "that there is no other country in the world where so great a number of gentlemen

[1] *Memoirs of the Science Department, University of Tokio, Japan.* Vol. I, Pl. I. Shell Mounds of Omori. By EDWARD S. MORSE, Professor of Zoölogy, University of Tokio, Japan. Published by the University, Tokio, Japan, 2539 (1879). 8vo, pp. 36, with 18 plates.

interested in archæology can be found as in Japan." Indeed there is a native archæological society in existence which holds regular meetings.

The Omori mounds lie six miles from Tokio, about half a mile from the shores of the Bay of Yeddo, and as shell mounds are naturally cast up near the shore, this indicates that the land has been elevated since their formation. These mounds differ from those of Denmark and New England by the great amount of pottery contained in them, by the great scarcity of stone implements, and by the absence of arrow-heads, spear-points and other pointed implements of stone, not a single arrow-head, flake or chip having been found after prolonged search, though rude stone hammers, celts and rollers, and instruments of bone occurred; but any ornaments for personal adornment, such as are worn by the Ainos, were entirely absent. While the remains of the monkey, deer, wild boar, wolf and dog occurred, the human bones were found to have been broken, "either with the object of extracting the marrow or for convenience of cooking in vessels of too small dimensions to admit them at length," while the bones were, in some cases, "strongly marked with scratches and cuts." These evidences of cannibalism are paralleled by those of the aborigines of Florida. Flattened tibiæ also occurred. The author also compares the shells found in the mounds, and discovered that much as on the coast of New England and Florida, they are now less abundant and smaller. While changes in the relative proportions of the shells of certain molluscs have taken place, the modifications in the relative size and proportions of certain species being considerable, and seeming to indicate "either that species vary in a much shorter time than had been supposed, or else that deposits presenting these peculiarities have a much higher antiquity than had before been accorded them." The differences seemed to be decided, though still within specific limits, and to have been produced at a minimum of 1500 to 2000 years, Japanese history extending back thus far.

The plates, printing and manufacture of the book is of Japanese origin, a Japanese as well as an English edition having been printed.

GROWTH AS A FUNCTION OF CELLS.[1]—Under this title Mr. Minot discusses the subject of the increase of bulk, weight, etc., which attends the development of an individual organism from the one-celled egg-stage to maturity and death. The exponential formulæ presented, expressing the rate and consequences of growth, are just about as unsatisfactory as they well can be, and, while we would not for a moment doubt the accuracy of Mr. Minot's facts, the attempt to express the laws of growth, which

[1] *Growth as a Function of Cells.* By CH. SEDGWICK MINOT. Proceedings Boston Soc. Nat. Hist., 1878–79. Vol. XX, Pt. II, p. 190.

are themselves determined by the incidence of variably potent forces which again interact variably, producing variable resultants, the propriety of expressing biological equations by x, y, generations by n, and their variables by $\pm n$, powers of these or any other desirable arbitrary symbols, becomes apparent. The results to science of this method of treating the subject, while perfectly proper and right if a person chooses so to state them, may be fairly questioned.

There seems just now to be a mania amongst biologists for re-naming things when they remodel old definitions. Although Huxley may define the *individual* as the result of the development of a single egg, and Haeckel define and call it a *person*, a *virtual* or an *actual bion;* our author now under notice, thinking that, because it has recently been discovered that the ovicell, by impregnation, becomes blended with the spermatozoōn, justifies him in coining a new term derived from that much-tortured Greek word from which so much *bio*logy has been extracted, for re-christening the individual under the name of *biad.* The nominal rubbish of scientific literature is acquiring huge proportions; for we already have for the cell, *plastid*, *protoplast*, *bioplast*, *amœboid;* and for special forms of it, terms too many to catalogue here. On this ground the proposition to re-name an old thing is ill-advised, and it may be doubted whether *zygote*, the name proposed for the result of the fusion of the male and female cell elements in certain plants, by Strasburger, may not properly supercede *biad*, while the word *gamete*, proposed by the same author, will answer all practical purposes in designating the reproductive elements of separate sexes. When one is worried with getting at the import of some recently coined term, so often needlessly imposed by some of the evolutionary school of scientific thinkers, Haeckel and his followers especially, it is refreshing to turn to the pages of Darwin or Spencer, often to find the same questions treated in much better and plainer every-day English.—*J. A. R.*

WILLIAMSON'S FERN ETCHINGS.[1]—The dual character of this fine work makes it no less valuable to the amateur fern student and advanced pteridologist than to those who admire ferns for their beauty alone, as by adopting the geographical range of "Gray's Manual," and accompanying his plates with descriptive text, the author, while professing only to present a series of life-like fern etchings, has really given to us a complete hand-book of all the species found growing in the Northern, Middle and Eastern States, and, in the present edition, the Dominion of Canada.

The clear, concise descriptions and faithful representations of the ferns themselves, will make this book an invaluable and indis-

[1] *Fern Etchings.* By JOHN WILLIAMSON, author of the "Ferns of Kentucky." Published by John P. Morton & Co., Louisville, Ky, 1879. 2d edition, 70 illustrations. Price $7.50.

pensable companion to fern collectors; while those who look upon ferns as beautiful objects to be admired rather than studied, will find enough in these charmingly executed etchings of Mr. Williamson to satisfy and delight them.

The etchings, which are printed direct from the original copperplates, and in the present edition by the author himself, are beautiful examples of the author-artist's special work, and will add greatly to his reputation as a faithful interpreter of fern life.

The desire to obtain copies of Mr. Williamson's fine etchings printed direct from his own plates, has led to the publication of the present work, and, as the number of copies printed must necessarily be limited on account of the expense of the etchings, those wishing copies will need to send for them early. No fern library will be complete without a copy.—*G. E. Davenport.*

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GENERAL NOTES.

BOTANY.

MOTHS ENTRAPPED BY AN ASCLEPIAD PLANT (PHYSIANTHUS) AND KILLED BY HONEY BEES.—Towards the last of September, Mr. John Mooney, of Providence, an observing man, brought us a stalk of *Physianthus albens*, an Asclepiad plant originating in Buenos Ayres, with the bodies of several moths (*Plusia precationis*) hanging dead by their proboscides or maxillæ. It was found that the moths had, in endeavoring to reach the pollen pockets, been caught as if in a vise by one of the opposing edges of the five sets of hard horny contrivances covering the pollinia. A few days after, Mr. Everett A. Thompson, of Springfield, Mass., wrote us, that he had a plant of the same species which had caught a number of moths of several species, and that in some cases only the heads and tongues of the moths were left, and he attributed this dismemberment to birds, but wrote in the same letter that his father had seen bees sting the moths while alive and struggling. He sent me one of the moths, which proved to be a *Plusia precationis*, the same species as we had observed in Providence, and a honey bee (*Apis mellifica*) which had been seen by his father to attack the moths, and which had a pollen mass of the same plant attached to one of its fore legs. On writing Mr. Thompson that his father's observations were quite new, the hive bee not being known to be carnivorous, beyond its well-known habit of stinging and killing the males of its own species and the bee moths invading its cells, his father, Rev. L. Thompson, of North Woburn, Mass., a careful observer, kindly prepared the following statement:

"I cannot undertake to give an account of my observations of the plant, moths and bees, concerning which inquiry is made, from the standpoint of a scientist, which I do not claim to be, but after pretty close watching, continued for many days, I feel quite confident of the general correctness of the following statement:

"Early in September, of the present year, as I made one of my daily visits to the plant, to me unknown before, the *Physianthus albens*, or Arauja, I noticed among the many moths that had been caught in the flowers, a considerable number of tongues still in the traps, while all, or nearly all, else belonging to the recent captives had disappeared. While I stood gazing, my attention was arrested by two or three bees buzzing immediately around as many entrapped moths that were alive and struggling to get away. Every moment or two, the bee suddenly and furiously darted upon the prisoner and seemed to me to sting it despite its desperate efforts to escape. This onset was generally instantaneous, but was repeated again and again, and, after the moth became still and apparently lifeless, the bee settled upon it, and, if my eyes did not greatly deceive me, began to devour it. I had previously noticed the tongues but supposed the bodies of the moths had been eaten by birds, though I had not actually seen it done. I cannot therefore positively assert what seemed to me the fact at the time, though I had no other thought, and the fact that so many of the moths had actually disappeared, leaving only their tongues, and, in some cases, other fragments of their bodies, in the shape of legs clinging to bits of casing or skin, satisfied me that the bees had really feasted on animal food as well as upon the nectar of surrounding flowers.

"I did not suppose it to be the honey bee at the time, but a kind of wasp, such as or similar to that whose nest I had sometimes found in sodded banks or terraces and looked upon as an architectural wonder. Yet I did not examine it, and can only say that I saw many, or supposed I did, upon a bed of Nasturtiums and other flowers, a few feet distant from the Physianthus.

"I think I have found as many as three or four different kinds of moths upon the plant, besides numerous small black flies which, unlike the moth, go down *bodily* into the flower.

"L. THOMPSON.

"*North Woburn, Oct. 29, 1879.*"

Upon writing Dr. Hermann Müller in reference to these facts, he replied as follows:

"Lippstadt, Nov. 10, 1879.—*Physianthus albens* has been observed by Delpino as being visited by humble bees and fertilized by their proboscis. It is a new and very interesting fact that *Plusia precationis* is caught by the flowers of this plant and has been found dead suspended by its proboscis. About carnivorous habits of bees, my brother Fritz, in south Brazil, has observed that honey bees (but I do not remember for the moment whether Apis

or stingless Brazilian honey bees) licked eagerly the juice dropping from pieces of flesh which had been suspended in order to be dried in the open air. Nothing else as far as I know has ever been published on the carnivorous habits of bees; I hope, therefore you will soon publish your very interesting observations."

We have also received the following letter from Mr. Darwin, dated Down, Beckenham, Kent, Nov. 23d. "I never heard of bees being in any way carnivorous, and the fact is to me incredible. Is it possible that the bees opened the bodies of the Plusia to suck the nectar contained in their stomachs? Such a degree of reason would require repeated confirmation and would be very wonderful. I hope that you or some one will attend to the subject."

We have also received the following note from Prof. Gray in reference to the subject: "It has long been familiar, and must several times have been recorded, that moths or butterflies and other insects are caught by getting their tongue, proboscis or legs into the chink between adjacent wings of the anthers in *Physianthus* or *Araujа albens*, and *Asclepias*, etc. The anther-wings are very rigid, the groove between them narrows gradually upwards, so that when a leg or proboscis is engaged, an upward pull only fixes it more securely, and the unhappy insects seem rarely to pull backward or downward, which is the only way to get disengaged. As to the rest of your account I know nothing; and should say that the observations need, if not 'repeated confirmation,' at least some confirmation by an entomological observer."

It appears from the fact that the single worker bee received had a pollen-mass attached to one of its fore legs, that it visited the plant originally for the sake of its nectar. For what purpose did it attack, kill the moths and, as is claimed, "devour" them? We publish the observations of Mr. Thompson and the comments upon them, with the hope that the subject will receive attention next summer.

Since this note has been put in type, Prof. A. J. Cook, of the Agricultural College of Michigan, well known as an apiarian of experience, informs us that *within the hive*, honey bee workers in killing the drones tear them in pieces with their mandibles rather than sting them, and that he has seen them thus kill a humble bee that had entered the hive; it thus appears, what we judge will be quite new to entomologists, that the honey bee uses its mandibles, at least on some occasions, as weapons of attack, quite as much as the sting; this would also corroborate the exactness of Mr. Thompson's observations.—*A. S. Packard, Jr.*

PROF. HEER ON SEQUOIA.—At the recent meeting of the Helvetic Society of Natural Sciences, Professor Heer read a paper in the Botanical section, on the palæontological history of *Sequoia*. This genus is now represented by only two distinct species, forming the celebrated forests of big trees in California, and known to

botanists as *S. sempervirens* and *S. gigantea.* Prof. Heer finds that the genus attained its greatest development during the Tertiary epoch, though it was before largely represented in the Cretaceous. Between the two types above named, palæontological collections have furnished as many as 24 fossil species; of which number 14 belong to the Tertiary, and 10 to the Cretaceous. The lower chalk alone furnishes 5, two of which, strange to say, are closely similar to the surviving species (if not identical). *Sequoia* has not, as yet, been found in Jurastic formations, though these are rich in Coniferæ.

BOTANICAL NOTES.—The *Bulletin* of the Torrey Botanical Club for October, contains notes on the flora of the Lake Superior Copper region, by A. Hollick, and descriptions of the new fungi, by F. Baron Thueman.——In the *Botanical Gazette* for November, C. H. Peck describes new species of fungi; T. Meehan remarks on Viscidity as a seed-distributor; while Dr. Gray notices *Vaccinium macrocarpon*, var. *intermedium* of the Columbia river.——To the *California Horticulturist* for November, Mr. B. B. Redding contributes a note on the valuable edible qualities of the camass root, which is extensively used as an article of food by the Indians of the western Territories and the Pacific slope.——In Trimen's *Journal of Botany* for November, Mr. S. H. Vines describes the alternation of generations in the Thallophytes. The recent deaths of Mr. John Miers in the 72d year of his age, and of Fenzel, the Austrian botanist, are announced.

ZOÖLOGY.[1]

CHANGES IN THE SHELL OF LIMNÆA MEGASOMA PRODUCED BY CONFINEMENT.—In a paper by R. P. Whitfild, read at a late meeting of the Boston Society of Natural History, and entitled, "Description of the animal of *Lymnæa megasama* Say, with some account of the changes produced by confinement in aquaria and under unnatural conditions," Mr. Whitfield states that he succeeded in keeping alive a specimen of this species in an isolated position in an aquarium in his house at Albany. These specimens were obtained at Burlington, Vt., in the summer of 1867. Two of them speedily died, but the third one survived the change to its new abode until the following spring. In February it laid eggs supposed to have been unimpregnated. After twenty days the animals escaped from the eggs. In the spring of 1868 many of these were removed to localities in the vicinity of Albany. During February, 1869, those of this lot still remaining in the aquarium deposited their eggs, and again during the early part of the following summer.

From the winter brood, specimens were reared which deposited eggs in the early part of 1870.

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

The first and second generations were each smaller than the parent stock, and this last, a third generation, had a shell only about four-sevenths as long as measured by the figures.

The animals of Lymnæa are perfect hermaphrodites, combining in each individual both male aud female organs, therefore it is not likely that the original ancestor of Mr. Whitfield's group was a deficient specimen. Nevertheless, besides the diminished size and spire, Mr. Whitfield found that the male organs had disappeared and the liver become considerably reduced in size. A diœcious species had, therefore, in all probability become a monœcious one on account of its removal to the aquarium.

This paper reminds us very strongly of the researches of Carl Semper upon Lymnæa, in which he shows that the supply of food and other things being equalized in a number of aquaria, that the size of the shells depends upon the temperature. A low temperature being inimical to the development of the largest size in any species.

In this case Mr. Whitfield, who is a palæontologist well known to workers in his own field, did not undertake his researches with the idea of conducting an experiment, but has, nevertheless, brought out a very similar series of modifications. Curiously enough, however, he took a species which reaches a very large size in northern waters, and introduced it to the almost tropical climate of a home aquarium.

Mr. Whitfield has certainly been very fortunate in leading the way into this field of research in experimental zöölogy with so suggestive a paper.—*A. Hyatt.*

INFLUENCE OF POISONS ON CRUSTACEA.—The influence of some of the principal poisons on crustacea has lately been experimented on by M. Yung. The animals treated were the crab and lobster. It was found that curare acts on these animals in the same way as on vertebrates, but with much less power; it produces difficulty of movement, which may go the length of complete paralysis. Strychnine, again, acts with extreme violence, causing strong (though temporary) tetanus. The muscular exhaustion is quicker than in vertebrates. A crab will live a long time in water charged with sulphate of strychnine, which shows that the poison is not absorbed by the branchiæ. Sulphate of atropine never caused death. The animal seems to eliminate this poison after a period of debility, preceded by tremblings. Digitaline quickens (shortly), then renders slower, the heart's movements. The action of nicotine is characterized by extreme rapidity. This poison is as violent for crustacea as for vertebrates.

DIFFERENCE IN THE HABITS OF SCALOPS AQUATICUS AND SCAPANUS AMERICANUS.[1]—A valued correspondent, Mr. Elisha Slade, of Somerset, Mass., finds decided differences in the habits of the

[1] For this latter name see AMERICAN NATURALIST, XIII, 1879, p. 189.

common and the hairy-tailed moles. According to his observations, the latter prefer rather dry ground, while the former is sufficiently fond of low moist soil to merit its specific name, *aquaticus*. Though the common mole is not aquatic in the sense a mink or muskrat is, it voluntarily enters the water and procures a part of its food in that element, such as water bugs, worms, &c. It is known in Mr. Slade's locality as the marsh or water mole, the hairy-tailed being called the upland mole.—*Elliott Coues, Washington, D. C.*

THE COTTON-WORM MOTH IN RHODE ISLAND.—On the evening of the 30th of September, a specimen of *Aletia argillacea* flew into my study, in Providence. The moth was in a perfectly fresh condition and bore every appearance of having quite recently emerged from the chrysalis. Its appearance certainly did not bear out the theory that all the northern individuals fly northward from the cotton belt. Several years ago I captured, in August, on Coney Island, in Salem harbor, Massachusetts, several fresh specimens, which indicated that they had originated not far from, if not on, the little islet on which they were flying in the day time.—*A. S. Packard, Jr.*

NOTES ON PHYLLOPOD CRUSTACEA.—We have received from Florida, through Mr. C. Gissler, a new Branchipus-like form which may be called *Streptocephalus floridanus*. While the females of this genus do not present decided diagnostic characters, the male is distinguished by the form of the claspers, whose tips, when drawn forcibly straight out, will reach to the end of the last pair of feet. The two basal filaments are as in *S. texensis* Pack.; of the forceps at the end of the claspers, the filaments are much shorter and smaller than in *S. texensis*, so much so that there is no need of confounding the two species, and besides in the Floridian species the processes are less broad and flat, and the inner of the two blades of the forceps have but one instead of two teeth. While of the same size as *S. holmani*, the male claspers are very much larger, and they are longer than in *S. watsoni* Pack., from Kansas; with the latter species it need not be confounded. It approaches *S. texensis* nearest in the robustness of the body, in the form and size of the caudal appendages, which are much stouter than in the other two species, and equal, in length, the three last abdominal segments. It seems to approach *S. similis* Baird, which inhabits St. Domingo, but that species is not described with sufficient exactness to enable us to compare it properly.

From Mr. Gissler we have also received specimens of *Limnetis gouldii* Baird, found by him in March and April, on Long Island. From Mr. R. P. Whitfield we have received specimens of *Estheria watsoni* Pack., collected by Dr. C. A. White on the Vermilion river, Colorado, in company with *Lepidurus bilobatus* Pack.—*A. S. Packard, Jr.*

The White Bellied Swallow (*Iridoprocne bicolor*).—In the Naturalist for November, 1879, p. 706, Mr. Allinson notes having seen swallows, at Beach Haven, N. J., which he took for the bank swallow, *Coytle riparia*, and that he was surprised to find in their excrement the seeds of the Bayberry. I think there can be no doubt that the species was the white-bellied swallow, *Iridoprocne bicolor*, which does feed in part on the waxy fruit of *Myrica cerifera*. Seventeen years ago I kept the *I. bicolor* as a pet, giving it the freedom of a room, in one corner of which I kept a bush of the bayberry, or American myrtle, changing it, as soon as the berries were picked off. I also fed it with house flies, of which it was very fond. The bayberry is a hard nut-like seed, and its cinereous or whitish covering of wax is a mere pellicle. As food for the birds, it amounts to little, unless it can have it in large quantity and very often. If, so far as known, the *bicolor* is exceptional among the swallows in this matter of a mixed diet, I think it is equally so in its habits, for it is far less aërial, and more terrestrial, than the other members of its tribe. Of the nearly one hundred species of swallows in the world, it seems to me that *I. bicolor*, which is peculiarly American, is an eminently specialized type.[1]—*S. Lockwood, Freehold, N. J.*

Vibration of the Tail in Racers.—In the September number of the Naturalist, Mr. F. H. King states he has observed the fox snake (*Coluber vulpinus* Cope) making a buzzing noise by rapidly vibrating the tail. In the November number, Mr. C. Aldrich makes a similar statement in regard to *C. obsoletus* var. *confinis* B. & G.; I have, in a number of instances, observed the same habit in *C. emoryi* Cope, which is a common species with us. I have never known the noise to be made, unless his snakeship was first directly disturbed or teased. The sound is usually made by elevating from three to four inches of the tail at an angle of near 70° from the horizon, then giving it a very rapid lateral motion. When it strikes leaves or other loose objects, there is, in addition to the buzzing sound, the rattling noise of the objects struck, proving that the first sound is probably produced by the rapid vibrations of the tail in the air. As this habit has been observed in three of the six species of this genus, may it not be true of all belonging to it?—*J. Schneck, Mt. Carmel, Ill.*

Fork-tailed Eumeces fasciatus and the Variableness of this Species.—During the last few years the periodical literature has been quite prolific with notes on monstrosities in the animal kingdom. Prof. J. Wyman reported a specimen of the common garter snake (*Eutænia sirtalis*) with two heads. Mr. J. W. A. Wright gives an account of a gopher snake (*Pityophis* sp.?); Dr. H. C. Yarrow describes a specimen of *Ophibolus*

[1] Mr. Lockwood's remarks bear out the advisability of recognizing for this species the genus *Iridoprocne*, lately proposed by us, Birds, Colorado Valley, p. 412, 1878. —E. C.

gluteus, and Mr. J. S. Kingsley mentions a specimen in Williams College museum, in all of which there are two heads. Mr. J. S. Kingsley also mentions a five-legged frog (*Rana palustris* Le Conte) taken near Rochester, N. Y.; and Mr. J. Stauffer also mentions a similar specimen of the same species taken near Lancaster, Pa. In the *Oölogist* for August, 1879, mention is made of two specimens of ruffed grouse (*Bonasa umbellus*) one of which had ten and the other twelve toes. Mr. W. N. Lockington gives an account of a one-toed deer, and finally, Dr. E. Coues describes a race of one-toed hogs.

To the above I wish to add, that I have seen three specimens of our common blue-tailed lizard (*Eumeces fasciatus* S.) with forked tails. The specimens were all taken near New Harmony, Ind. Two are now in the collection of Mr. J. Sampson, of that place. The two prongs are near the same length, and as I remember, near three inches in length in all the examples seen. The two prongs form an acute angle of near 35°, and are attached to a short stub of the natural tail, which appears to have been broken off. I have also seen a number of specimens in which part of the tail was gone. Is it not probable that in the forked-tailed examples, this member was first broken off, and in the restoration this unnatural growth was assumed? While I am speaking of *Eumeces fasciatus*, I will mention the exceeding variableness of this species. From the small, blue-tailed, striped lizard, three inches in length, to the large, ruby-headed, copper-bellied specimen, twenty inches in length and no stripes at all, every conceivable grade is found. A comparison of twenty-eight specimens show ten well marked stages, each of which, taken alone, would make a good species.—*J. Schneck, Mt. Carmel, Ill.*

ZOÖLOGICAL NOTES.—The *Proceedings* of the U. S. National Museum contain a number of descriptions of marine invertebrates, by Prof. A. E. Verrill; with notes on New England Isopoda, by Mr. Oscar Harger. The material was collected by the U. S. Fish Commission.——In the *Proceedings* of the Boston Society of Natural History, Vol. 20, Mr. W. H. Patton gives a synopsis of the New England species of Colletes.——In the *Canadian Entomologist* for November, Mr. W. H. Edwards describes the egg, larva and chrysalis of *Argynnis idalia*. It is stated that Prof. Comstock, Entomologist of the Department of Agriculture, is endeavoring to prepare a biological collection of insects on such a scale and in such a manner as shall be a credit to the government. Special attention has been paid, the past year, to insects feeding on clover, the collection now containing over fifty species known to be destructive to this valuable crop.——A catalogue of the beetles of Japan, by G. Lewis, enumerates 2227 species. These represent many European genera, and in many cases are specifically identical with European forms.——We have received an

essay by Dr. Hermann Müller on protective mimicry in German insects, with some excellent cuts.——Mr. H. J. Carter, having already published an article on the probable nature of the animal, of Stromatopora, and a second on its mode of growth, prints a third paper on the structure of this fossil, and shows its relation to the Hydractinia, in the *Annals and Magazine* for October. In the November number he discusses the nutritive and reproductive processes of sponges. Carter and Lieberkühn have shown that Infusoria and particles of Algæ are taken in as food by the cells of the ampullaceous sacs, whether the cells are ciliated or not, while Metschnikoff has shown that the cells of the parenchym (mesoderm) also are alimentary cells. Thus every part of the spong-parenchyma is capable of enclosing nutritious material and digesting it.

ANTHROPOLOGY.[1]

ANTHROPOLOGICAL NEWS.—We are pained to hear of the death of Mrs. Rev. Stephen Bowers, wife of the eminent archæologist of Santa Barbara, California. She was devoted to her husband's labors, accompanying him in all his expeditions, and was herself an intelligent collector.

We have received from the editors of the Journal of the Victoria Institute, four pamphlet copies of papers from that publication bearing the following titles: The Ethnology of the Pacific, by the Rev. S. J. Whitmee; The caves of South Devon and their teaching, by J. E. Howard; The contemporaneity of man with the extinct mammalia, as taught by recent cavern exploration, and its bearing upon the question of man's antiquity, by Thomas Karr Callard; The lapse of time since the Glacial epoch, determined by the date of the polished stone age, by J. C. Southall.

Prof. George M. Dawson is the author of a pamphlet, reprinted from the *Canadian Naturalist*, entitled, Sketches of the past and present condition of the Indians of Canada. The Indian population of the Dominion is set down at 100,000.

Dr. Gustav Brühl sends to the Smithsonian Institution a pamphlet of sixteen pages, entitled, Aztlan-Chicomoztoc, eine ethnologische Studien. New York, Cincinnati and St. Louis, printed by Berziger Brothers.

Two very interesting brochures from the pen of Prof. Boyd Dawkins have reached us. One of them treats of the range of the mammoth in space and time, and appeared in the Quarterly Journal of the Geological Society for February, 1879. The other is upon our earliest ancestors in Britain, constituting No. 6 of Science Lectures for the People, and was delivered in Manchester, Jan. 18, 1879.

The *Journal of Anatomy and Physiology*, Vol. XIV, contains a paper, by Prof. W. H. Flower, on the scapular index as a race character in man.

[1]Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

The May number of the *Journal of the Anthropological Institute* contains the following papers: Some American illustrations of the evolution of new varieties of man, by Dr. Daniel Wilson; A revised nomenclature of the Inter-oceanic races of man, by Rev. S. J. Whitmee; Ethnological notes on the Motu, Koitapu and Koiari tribes of New Guinea, by Rev. W. G. Lawes; Notes on a skeleton found at Cissbury, April, 1878, by Prof. Geo. Rolleston; Illustrations of the mode of preserving the dead in Darnley island and in South Australia, by Prof. W. H. Flower. On page 402 is the address of the retiring president, giving an abstract of the work done during the year.

Dr. Wilson's paper in the *Journal* is devoted to a subject upon which he has bestowed a great deal of thought, the preservation of our aborigines, not by legislation but by a species of natural selection, through which a new race of men is being produced between the white race and the aborigines. The introduction of the black race and the Chinese increases the complexity of the problem and awakens some of the most curious questions in anthropology.

The communication of Mr. Whitmee is important, not only on account of his long familiarity with the Polynesian races, but also for the discussion which followed it. There are two broad and very distinct divisions of these people, the *dark* and the *brown* races; the dark occupying Australia, the Andaman islands, portions of the Indian archipelago and Western Polynesia; the brown being found in Madagascar, the Indian archipelago, Formosa, Northwestern and eastern Polynesia, together with New Zealand. Mr. Whitmee's division of these races is represented in the following table:

Inter-Oceanic Races of Men	Dark Races Negrito-Polynesian	Austral	Australia
		Negrito	Andaman Is. Samang, etc.
		Papuan	Aru Is. Western N. Guinea Western Polynesia
	Brown Stock Malayo-Polynesian	Sawaiori	Samoa Hawaii N. Zealand, &c.
		Malagasy	Madagascar
		Formosan	Formosa
		Malayan	Malays of Sumatra, &c. Javanese, &c.
		Tarapon	Caroline Is. Marshall Is. Gilbert Is.

Mr. Wallace, who contributes the volume on Australasia and

Polynesia to Stanford's Compendium of Geography and Travel, and Prof. Flower, objected to several of the new appellations given by Mr. Whitmee. The map illustrating this paper will be found in the February number of the *Journal.*

The seventh part of *Anales del Museo Nacional de Mexico* is entirely devoted to Archæology, and contains the following papers: Códize Mendozino: Ensayo de descrifacion geroglifica, by Sr. D. Manuel Orozeo y Berra; Cosmogonia Azteca, by Prof. G. Mendoza; La Piedra del Sol: segundio estudio, by Sr. D. Alfredo Chavero; El Congreso Internacional de Americanistas en Europa y el cobre entre los Aztecas, by Sr. D. Jesus Sánchez; Anales de Cuauhtitlan.

Vol. I, Part I, of the Memoirs of the Science Department, University of Tokio, Japan, is devoted to the Shell Mounds of Omori. The author, Prof. Edward S. Morse, having for years studied shell heaps in Maine and Massachusetts in company with Prof. Jeffries Wyman and Prof. F. W. Putnam, was well qualified for the examination of these remains, and has made good use of his opportunities.

These mounds possess those common characteristics which distinguish shell deposits throughout the world. They have, likewise, the following special marks: 1. The presence of enormous quantities of pottery, of many different shapes, and of an almost infinite variety of ornamentation. 2. By the great scarcity of stone implements, and the absence of arrow-heads, spear-points and other pointed implements of stone. Not an arrow-head, flake or chip has been found by the various parties that have been there in the interests of the university. 3. The men of the Omori period were also cannibals. 4. Peculiar clay tablets or amulets. The pottery is minutely described and illustrated by fifteen double lithographic plates. In form and marking it resembles in a striking manner the fragments in the Latimer collection, figured in the Smithsonian Report for 1876. The tablets are of the finest clay, light colored; two of them have designs in relief, with depressed areas; on the others the figures are cut on a flat surface. The author ventures a comparison with American tablets, but is not able to reach any definite conclusion.

The opinion of cannibalism is founded on the same evidence as is offered by Prof. Wyman, but as savages break human bones for other reasons than a design to eat the flesh, the theory must take its chances with the rest. With much diffidence we would call Prof. Morse's attention to Le Moyne's plate 15, descriptive of the Indians occupying, in 1564, the very spot where Prof. Wyman found his evidences of cannibalism. "When a battle was fought the victors seized upon the enemy and mutilated their bodies in the most brutal manner. With cane knives the arms and legs were cut around and then severed from the body by blows upon the bones from wooden cleavers. The head was also cut around

with these knives, just above the ears, and the whole scalp jerked off. These were then rapidly smoked over a fire kindled in a small round hole, and borne off in triumph towards home, together with the arms and legs, suspended upon spears." Upon arriving at home they suspended these mangled limbs and trophies and danced around them in honor of their victory. Again, in arranging the Wilkes collection for the National Museum, I was struck with the great number of spear-points made of human bones. The question occurred to me then, and has been revived by Prof. Wyman, whether any magical effect would be attributed to spear-points made of the bones of a brave enemy. The absence of pointed bone in Omori would, of course, exclude the spear-point or implement theory. In conclusion, we consider Prof. Morse's memoir one of the most important contributions to archæology for the year 1879.

Numbers 3, 4 and 5 of *Materiaux* contain the following papers of interest to general students: Les pierres a bassin et les rochers a écuelles dans la Lozère, by G. de Malafosse; A Review of Evans' Ancient Stone Implement in Great Britain; Palæo-ethnological bibliography for the year 1878, by L. Pigorini; The Tenevières of the Swiss lakes, by Dr. Forel; The latest archæological publications in the North, the Archæological Society of Finland, by E. Beauvois; Upon the origin of domestic animals, by G. De Mortilet; New anthropological publications in the German language; Study upon ring-money and its use among the Germans, by Dr. Much. The article by Dr. Forel upon the *Tenevières* of the Swiss lakes is a very important one indeed. In M. Desor's classic work upon the palafittes of Lake Neuchâtel, the author describes certain little submerged stone mounds, formed, apparently, by heaping rocks around the bases of piles. When the lakes subside, the mounds form true islets. Dr. Forel's article is to show that many of these are of geological formation, being the natural consequence of a talus forming at the foot of a bluff.

GEOLOGY AND PALÆONTOLOGY.

THICKNESS OF THE ICE SHEET ON ITS SOUTHERN EDGE.—At the Saratoga meeting of the American Association for the Advance of Science, Professor J. C. Smock spoke of the surface limits of thickness of the Continental glacier in New Jersey. The existence of a great terminal moraine and a southern limit to the glacial drift in New Jersey and the adjacent States, were pointed out to the author in 1876, by Professor Geo. H. Cook. In that year the southern limit of the glacial drift was traced across the State from South Amboy to a point on the Delaware river, near Belvidere. Details were given of further investigations in tracing this line. The paper considered two questions:—What was the thickness of the ice-sheet along its southern margin; and what

was the rise of its upper slope northward. The terminal moraine represents both materials carried forward under the foot of the glacier, and also the earth and stone carried on its surface and dropped in a confused mass as it melted and retreated northward. These accumulated heaps may in places have equaled in height the greatest thickness of the glacier front, although in general the moraine would fall short of the height of the glacier. As we see it, this terminal moraine raises greatly in height from point to point. It is possible to get at a minimum estimate of the thickness by considering the heights of some of the hills in the moraine. It is safe to conclude that the ice front of the great glacier was from 200 to 400 feet in thickness. A careful exploration of that part of New Jersey, which is north of the terminal moraine, has thus far failed to discover any peaks or crests which show no marks of a glacier.

WERE THE ICHTHYOSAURS VIVIPAROUS?—This is a question which Prof. Seeley sought to answer in a paper submitted to the Geological Society at a late meeting. From time to time specimens of Ichthyosaurs have been found, with the remains of small saurians preserved inside the body-cavity. Against the supposition that these small ichthyosaurs had been devored by the larger ones, it may be urged that their state of preservation is markedly different from that of the remains of food, such as the indigested residuum of fish, which are not unfrequently found in the stomach of the Ichthyosaurs. Moreover, the position of the small skeletons in relation to the larger ones, with which they are associated, is tolerably constant, and is such as to strengthen the supposition that the relationship is that of offspring to parent. From these and other considerations, Prof. Seeley concludes that the Ichthyosaurus must have been viviparous.—*Academy.*

MIOCENE FAUNA OF OREGON —Prof. Cope recently read a paper before the American Philosophical Society, describing additional species from the Truckee Miocene of Oregon. Several of these were Rodentia, one of which was referred to a new genus, under the name of *Paciculus.* Four were *Carnivora*, two *Canidæ* and two *Felidæ.* A new genus *Hyænocyon* was proposed for the *Enhydrocyon basilatus*, with the following dental formula: I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pre-m. $\frac{4}{3}$; M.—. The genus *Merycopater* was shown to be an *Oreodont* with deficient superior incisors. A new genus of *Oreodontidæ* was described under the name *Coloreodon*, with the following characters: A wide diastema in both jaws. I. $\frac{?}{3}$; C. $\frac{1}{1}$; Pre-m. $\frac{3}{4}$; M. $\frac{3}{3}$. Two species were described, a smaller *C. ferox*, and a larger *C. macrocephalus*, both of which have remarkably developed cranial crests. Three new species were added to the suilline division.

PLIOCENE MAN.—Special interest is attached to Prof. J. D. Whitney's recent volume upon the "Auriferous Gravels of the

Sierra Nevada," one of the official reports of the geological survey of California, though issued by the Museum of Comparative Zoölogy, because of the full description of the reported discoveries of man in the Pliocene Tertiary. These gravels are mostly consolidated into rock and are capped by lava, constituting the Table mountains. The original river valley is now completely filled by gravel and lava, so that the stream, driven out of its course, has been compelled to wear its way to depths varying from 1000 to 2000 feet on either side. Hence, the following events must have happened subsequently to the deposition of the human bones and implements in the bottom of the ancient river: (1) deposition of 130 feet of gravel over the human remains; (2) overflow of lava, completely filling up the valley, so that the river must change its course; (3) wearing down of gorges nearly 2,000 feet deep in hard slates on both sides of the lava flow, so as to carve out a flat-topped mountain. Much time must be required for the accomplishment of these results—hundreds of thousands of years, if the wearing of the Niagara gorge be taken for the unit of measurement. As glacial deposits are not known on the flanks of the Sierras, Whitney relies upon the character of the fossils exhumed to determine the age, and decides that the formation was the Pliocene Tertiary, anterior to the glacial drift of the East. The principal fossils are these: *Rhinoceros*, *Elotherium*, *Mastodon americanus* and *M. obscurus*, three species of horse, a wolf, a deer, *Hipparion*, *Auchenia*, etc. These were determined by Dr. Leidy. Lesquereux describes seventeen species of deciduous trees referred to the Pliocene, with suggestions of the Miocene. Various stone implements, including tools, pestles, mortars, platters, spear and arrowheads, are described from thirty different localities in eleven counties. Human bones were found under Table and in Bald mountain. All these facts are detailed with the utmost care, and it would seem to be clearly proved that human bones and implements are found in these gravels, associated with what are universally regarded as the fauna and flora of the Pliocene Tertiary. This is more satisfactory than any of the reported discoveries of human flints in the later Tertiary of Europe. No one would doubt the correctness of Whitney's conclusion if the question did not involve the age of man. Now, is it clear that the California Pliocene was the equivalent of the Eastern American and European Pliocene? There was no true glacial period in the Sierras corresponding to the Great Northern Drift; hence, may not the organisms of the Western Pliocene period have continued to live on till post-glacial times? Two suggestions agree with Whitney's conclusions: (1) the immense time required to excavate the deep cañons would correspond well with careful estimates of the length of the glacial period, and it is clear that man antedated the erosion of these valleys. (2) The cañon-making period in California and over the area of

the Fortietieth Parallel Survey is probably the equivalent of the glacial period of the East. It is so regarded by Clarence King, in his "Report," and was certainly subsequent to the time when the early men flourished.—*N. Y. Independent.*

The preceding abstract suggests the following observations. Some of the vertebrata reported as found with the human remains in the auriferous gravels are obviously out of place, or erroneously determined. Thus, *Elotherium* does not belong to the Pliocene fauna, nor even to the Upper Miocene (Loup Fork) but to the lowest Miocene or Oligocene (White river). *Mastodon obscurus* is Upper Miocene. How they come to be included in the list remains to be explained.

The occurrence of human implements mingled with the Pliocene fauna in Oregon, was asserted in this journal for 1878, p. 125, and some dozen species of vertebrata cited as cotemporaries. A more extended list of the mammalia was given in the Bulletin U. S. Geol. Surv. Terrs., 1879, p. 48; and of the birds in the same for 1878, p. 389. The entire number of vertebrata now determined from this locality in Oregon amounts to twenty-seven.

During the past summer the writer obtained bones of *Mylodon* from the auriferous gravels of the Klamath river, near Yreka, Cal., from excavations which he personally examined. He also obtained vessels of vesicular basalt which were undoubtedly procured from the same excavations.

The relation of this formation to the European Pliocene is discussed in an essay on the parallelism of the American and European horizons, in Hayden's Bulletin U. S. Geol. Surv. Terrs., 1879, February.—*E. D. Cope.*

GEOGRAPHY AND TRAVELS.[1]

HAYDEN'S NEW MAPS OF WYOMING, ETC.—The forthcoming reports of Dr. Hayden's Geological Survey, on the field-work of 1877 and 1878, will contain three topographical atlas sheets, of the same size, and on the same scale (4 miles to an inch) as those in the Colorado atlas. These sheets illustrate portions of Wyoming, Idaho and Utah, each of them covers 2½ degrees of longitude, and 1¼ degrees of latitude, and includes an area of about 11,000 square miles.

The south-eastern of the sheets covers the country from longitude 107° to 109° 30′, and from latitude 41° 45′ to 43°. It includes the barren plateaus of the continental divide, north of the Union Pacific R. R. The valleys of the Sweetwater and Wind rivers, and a part of the Wind River range.

The south-western sheet lies directly west of the latter, extending to longitude 112°. It embraces the Green River basin, and, farther westward, a succession of parallel ranges of no great

[1] Edited by ELLIS H. YARNALL, Philadelphia.

height, alternating with broad valleys drained by Bear river and branches of the Snake.

The third sheet lies north of the last, extending to latitude 44° 15′. Besides a small portion of the Snake River plains on its western edge, nearly all this area is occupied by rugged mountains. Among them may be noted the Tetons, the Gros Ventre and the northern part of the Wind River ranges.

The plan of the geographical work has been sketched in some detail in previous reports of this survey, and, therefore, nothing more than a brief epitome will here be attempted.

The whole work is based upon a system of triangulation, carried on with an eight inch theodolite, reading to 10″. In the scheme there were two base-lines measured, one near Fort Steele, Wyoming, the other on Bear River, in South-eastern Idaho. Each of these was between five and six miles in length. The mean error of closure of the triangles in the expansion was 5.3″. The sides ranged from twenty to seventy miles in length. Altogether, forty-nine points were located by the primary triangulation.

Secondary triangulation was carried on by a theodolite reading to minutes. The mean error of closure of secondary triangles is 3′.

The topography was secured from elevated points by map-sketches made on an assumed scale, with distances and angles estimated, and by perspective sketches, on which the topographical features were represented as they appeared to the observer at his station. All salient points in the landscape, peaks, angles of plateau, minor summits and hills, and junctions of streams, were located by intersections of sight lines from two or more stations, and in plotting the maps, in the office, the map-sketches are corrected by these locations. On these three sheets, about 3300 points, including stations, were located, being one in every ten square miles. Altogether, between 600 and 700 stations were occupied, or about one in each fifty square miles.

A few words as to the measurements of heights, and the method of construction of contour lines. Elevations were measured by means of the barometer, and the vertical circle of the theodolite. Camps, stations, and all salient points on the routes traversed, were measured by the former instrument. Aneroids were used but little and the results accepted with great caution. The vertical circle was used in determining the relative heights of all points within range of the stations—all peaks, passes, gaps, heads of spurs, etc., in short, everything that could be located, even approximately. Thus the heights of a great number of points were easily determined, and these, placed upon a perspective sketch, which may be supposed to be reasonably accurate, indicate approximately the heights of all portions of the sketch.

Difference of heights are expressed on these maps by contours. The space between two of these grade curves represents a differ-

ence of elevation of 200 feet. Where the slopes are gentle the curves are far apart, while among the cliffs of the mountains and plateaus, they are crowded together, in many places being almost run into a single line.

These curves are not "run," nor are they accurately located, as would be done in a minute survey. They do, however, express the orography, and, approximately, the elevation, over the whole map.

They are constructed mainly from the perspective sketches, aided and directed by the measured heights. As an example of the method of their construction, take a mountain spur, starting from the peak and extending to the valley below. Its summit and base, and each point of change of slope, are located, and their heights are known; we have also a profile sketch of the spur. Given these data, and what is easier than to distribute the curves with a considerable approach to accuracy, between those points actually determined.

This method of representing orography is a strictly natural one. Supposing the light to be vertical, grade curves must necessarily produce the same lights and shades as in nature. All the details of the topography, down to forms not above 200 feet in height may be expressed.

For masses for the representation of geological outcrops and formations, these grade curves are invaluable. They enable the geologist to draw accurately the outcrops not only of horizontal, but of inclined strata, over vast areas, from a few isolated observations. In many cases, by thus expressing the orography of a range, the key to its geological structure is supplied.

The maps of this Survey have been justly regarded as among the finest specimens of cartography ever published in this or any other country.

African Exploration.—Dr. Rohlf's expedition to Wadai left Bengasi on the Fourth of July, last, for the Kufara oasis. The oasis of Djâlo and Aujila were found to be ninety-eight and sixty feet respectively above the sea level. Heretofore they have been thought to be below it. At Kufara the party were attacked and plundered and obliged to return to Bengasi.——Dr. Oscar Lenz, well known for his explorations on the Ogoowé, has been sent by the German African Society to Morocco where he intends to cross the Atlas and investigate the geology and natural history of the southern districts. The Society also intends sending young travelers to this country, where they can get accustomed to Mohammedan life and become better fitted for longer journeys in Central Africa.——The *Academy* states that Mr. Donald Mackenzie has returned to England from Cape Juby, in North-western Africa, where, during his stay, many people came to enquire about trading and stated that there were numerous animals of all kinds in the interior, and the country was very fertile. Mean-

while, the French are proposing to construct a railroad across the Sahara to connect Algeria with the river Niger. The French Government has appointed a Commission to conduct preliminary investigations, and French engineers are exploring the line of the proposed road as far as the Laghouat on the south. M. Paul Soleillet will leave shortly for St. Louis, Senegal, under orders to visit the unexplored regions lying to the east of that colony as far as Timbuktu. The *Nature* states that at a recent sitting of the Paris Geographical Society, Mr. Soleillet read a paper proposing that the railroad be made from Dákkar, on the Atlantic coast, and St. Louis. The Senegal should be opened to navigation as far as Bafoulabé and a canal constructed from thence to Bamakou, on the Niger. The Niger is now navigable from Bamakou to Timbuktu and lower down for a distance of 1500 miles. The aggregate expense of the whole work is estimated at $5,000,000, and the population brought into close connection with Senegal at thirty-seven millions. These projects have been adopted by the High Commission and the survey for the canal will begin immediately. M. Soleillet believes that the semi-civilized races occupying the region he is to visit will be friendly to Europeans, and offer no obstacles to the success of this great project. The country from Senegal to the Niger is level, fertile and inhabited by two races, the Bambara and Solenké. Nothing would be easier than the establishment of a preliminary trade-road between the two rivers; it would suffice to mark out a straight line and clear it of bushes to enable a bullock-dray to travel for 200 or 300 miles. Amongst other products is a vegetable wax which can be reduced to oil, and made to serve many useful purposes in the arts.——Drs. Greef and Gasser have been despatched on a scientific mission to study the Zöology of the West African Islands.——By means of the electric light the junction of the Algerian survey with the European net-work of triangles has been completed.——One of the most important events in African exploration during the past year has been the discovery, by two Frenchmen, MM. Zweifel and Moustier, of the sources of the river Niger. Starting from Sierra Leone they ascended the Rokelle river and succeeded in crossing the Kong mountains, heretofore impassable in consequence of the hostility of the natives, and visited the heads of the three streams which, uniting after a short distance, form the Niger.

MICROSCOPY.[1]

IMPROVEMENTS IN CELL-CUTTING.—Cells cut from thin sheet wax or lead are rapidly coming into use. They can be built up one upon another to form deeper cells, but are most applicable where great thickness is not required, and have the great advantage that they can be prepared, as wanted, by anybody, of any required size, with very little trouble, and almost without

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

expense. The elegant preparations presented by Mr. Merriman at the Buffalo meeting of the American Society of Microscopists were mounted in cells of wax cut by punches made by Mr. Wm. Streeter, of Rochester. These instruments, as subsequently improved and as now made, are represented in section by Fig. 1. There is a set of four concentric tubes of iron or hard brass, of equal length, fitting smoothly within each other, and turned to a cutting edge at the lower end. When using the punches the cutting edges are to be moistened with water to prevent sticking to the wax, and the wax laid on some book leaves or writing paper to form a firm, smooth cushion. The smallest punch is then pushed through the wax sheet with a slightly rotating motion, and then the next one is placed over it and pushed down in the same manner, and so on to the largest. The inner punch is next withdrawn by a wooden peg or pencil thrust into it, and the others drawn out one after the other by the little finger. Each ring of wax is then pushed out of its punch with the top of the next smaller punch, leaving it flat and true. The three rings thus prepared are suitable for use with cover glasses of one-half inch, five--eighths inch and three-quarters inch diameter. They may be fastened to the slide by a little warmth and pressure only, or by some kind of cement. Before using they should be coated, on the turn table, with shellac or other suitable cement, which will not only form a coating to the wax but also secure it to the slide. Cells thus made are very dainty in appearance, and very serviceable. The punches can be obtained by mail from Mr. Wm. Streeter, P O. Box 73, Rochester, N. Y.

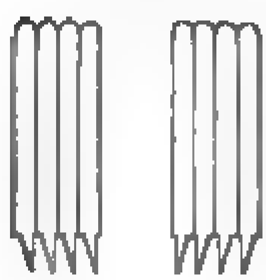


FIG. 1.—Streeter's punches.

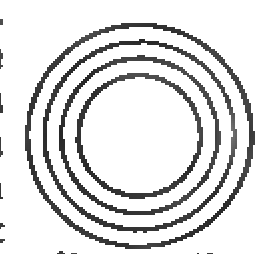
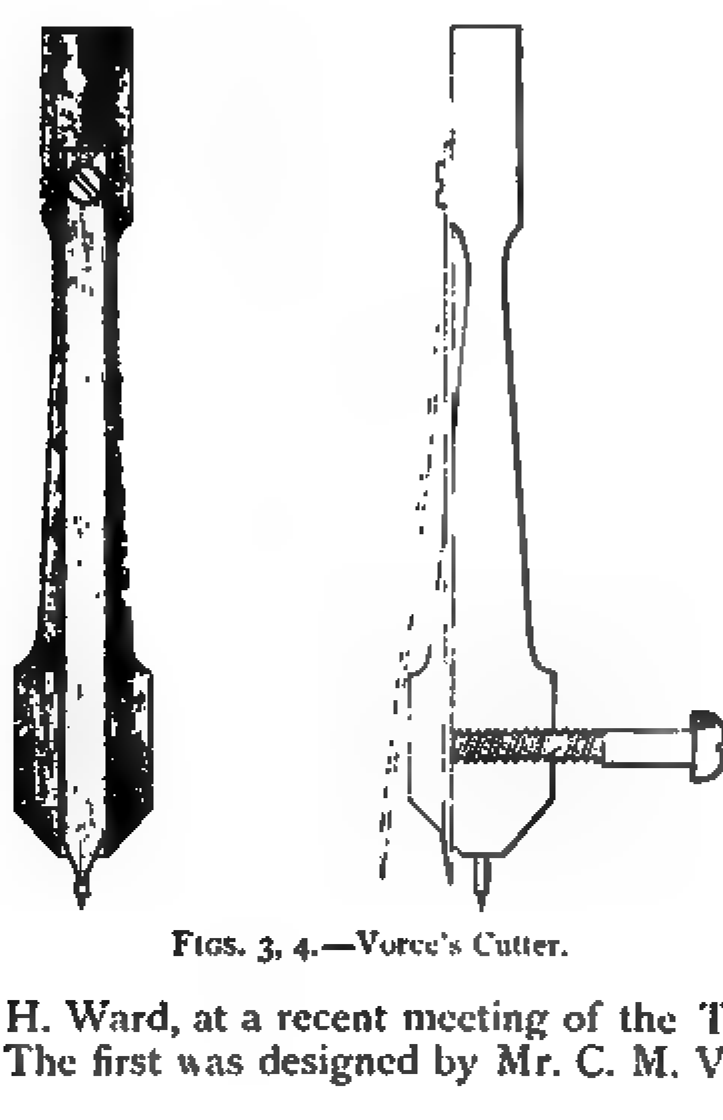


FIG. 2.—Concentric cells as cut.



FIGS. 3, 4.—Vorce's Cutter.

Of instruments adapted to cutting both wax and sheet-lead cells, two very convenient forms were brought forward by Dr. R. H. Ward, at a recent meeting of the Troy Scientific Association. The first was designed by Mr. C. M. Vorce, of Cleveland, O., and

is represented in front view and in section in Figs. 3 and 4. It can be readily made by amateurs for their own use. It consists of a wooden body of such size as to be easily held and twirled between the fingers, with a short needle point inserted in the center of the lower end. On one side a longitudinal slot or groove is cut through the wood deep enough to allow the cutting edge to approach nearly to the needle. The cutter is of steel, one-eighth or three-sixteenths inch wide, as a piece of skirt-steel or corset-spring, and is attached so as to lie in the groove and press toward the needle. The cutter should be ground to a triangular point, and ground only on the outside, leaving its inner face flat and smooth. A screw passes through the body of the instrument and bears against the spring, regulating its distance from the needle point. Greater firmness might be secured by changing the form of the body so as to support at its two edges the cutter when forced out to its farthest limit. The other instrument, shown in Fig. 5, was suggested by the Vorce instrument, and was contrived by Mr. Frank Ritchie, of Troy. It possesses greater power and precision than the other, but is not so easily made by an amateur. It consists of a pair of spring dividers about three and one-quarter inches long, from one leg of which half an inch of its length has been cut off and replaced by a brass socket with a binding screw to hold a small knife blade. A knob is also added at the top for convenience in manipulation. The method of working these two forms of apparatus is precisely the same. A sheet of wax may be laid on a sheet of heavy white paper, and both together tacked to a piece of smooth hard wood. The instrument with its legs set three-sixteenths inch apart, is used to cut out a series of discs of three-eighths inch diameter. How near together these can be safely cut will soon be learned by experience. The legs are then set one-quarter inch apart, and using the same centers as before, a series of rings can be cut suitable for one-half inch covers. By successively spreading the legs one-sixteenth inch further each time, rings may be cut around the same centers for five-eighths and three-quarters inch covers, and larger if desired. The concentric rings around each center are cut out without waste, as shown in Fig. 2. Not only wax but also sheet-lead, card-board and gutta percha can be cut with facility in this manner. The various tools sold by hardware dealers for cutting washers of leather, etc., have often been employed for this work, but they have proved too clumsy to be useful.

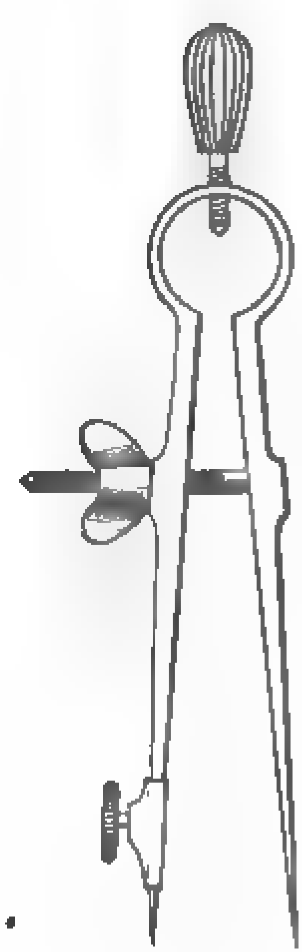


FIG. 5.— Ritchie's Cutter.

ANOTHER JOURNAL.—A successor to the late *American Quarterly Microscopical Journal* is announced, in the form of a monthly by the same editor, and in a more popular form. The first number is promised for the present month. The editor's name is a sufficient guarantee of the scientific spirit and energetic management of the new enterprise, which can scarcely fail, and ought not to fail, at the low subscription price of one dollar a year, to receive so general a support as to become self-sustaining and permanent. It is published by Romyn Hitchcock, at 51 Maiden Lane, N. Y.

ADULTERATIONS IN FOOD.—The prize offered last summer for the best two slides illustrating the adulteration of some common article of food, one slide to show the genuine article and the other to show an adulterated form actually sold and used, will be awarded at the meeting of the American Society of Microscopists, next summer. The donor, Mr. E. H. Griffeth, will substitute for the medal promised an objective suitably engraved, if preferred by the winner.

EXCHANGES. — Fine diatoms and other marine material for named diatoms, diatomaceous earths or other good mounted objects.—M. A. Booth, Longmeadow, Mass.

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SCIENTIFIC NEWS.

— In the *American Journal of Science and Arts* for December, Prof. James D. Dana, the editor, and who is, we need not remind our readers, one of the leading geologists of his time, reprints the bill for the establishment of the U. S. Geological Survey of the Public Domain, and adds his weighty comments on the "unexpected amendment" to this bill introduced by Mr. King, the geologist-in-charge, and passed by Congress at the extra session, by which the survey is extended over the whole area of the United States, including the States as well as the Western Territories. Prof. Dana observes that the amendment was not even "presented for public discussion, although it bears on the political and industrial interests of the country, as well as on the status of science under the General Government." Prof. Dana then adds that "Having been a member of the National Academy, the writer has felt it a duty here to state, that this proposed expansion of the field of work under the 'Director of the Geological Survey' is wholly foreign to the views expressed in the Report of the Committee, and to the opinions brought out in their discussions. Moreover, it is entirely at variance with the objects set before the committee by the Act of Congress requiring its appointment: this act asking that the members 'take under consideration the methods and expenses of conducting all surveys of a scientific character under

the War or Interior Department and the surveys of the Land Office, and to report to Congress as soon thereafter as may be practicable, a plan for surveying and mapping the Territories of the United States on such general system as will, in their judgment, secure the best results at the least possible cost.' The plan set forth by the committee, besides having direct reference to the Territories, had in view that economy of expenditure, suggested in the act of Congress; while the new scheme, with the proposed enlargement of its scope, would involve—as State geological surveys have shown—millions of outlay for the strictly geological part, and indefinite millions besides for the economical branch—the study of 'the mineral resources and products of the National Domain,' '*and the States*.'

"The writer is not informed as to the character of the discussion over the proposed amendment in the House of Representatives. But it seems to be plain, from the change of wording, that the meaning intended to be conveyed by it was that the director 'may extend his examination into States' *which adjoin Territories*. There is an evident absurdity in an expression which adds the States—nearly the whole country—to the Territories. Had the general survey of the United States been intended by the House, the idea would have been brought out by the simple substitution of the words United States for 'National Domain.' "

Prof. Dana also adds: " A change so great in the administration of the affairs of the Government should have a full discussion before it is accepted. It will appear to many that the Constitution has left to the States the making of their own geological surveys and the study of their own economical resources—as past history seems to attest—and that such an infringement on State rights and assumption of State responsibilities would be politically wrong; and also, that investigations into the mineral resources of the States, whether of a mine or of a granite quarry, would be followed by other evils through encroachments on private rights, and the temptations to favor private enterprises. The General Government, unlike many in foreign lands, has no ownership in the mines of California or of any other of the States, and hence has no need to establish a Mining Bureau for the country at large."

Coming from the source it does, this is a weighty protest, and is in the line of criticism adopted by this journal.[1] While the U. S. Geological Surveys under Hayden, Powell and the U. S. Engineers, Lieut. Wheeler in charge, were confining their attention to developing our knowledge of the natural resources of the Western Territories, with excellent results already accomplished and with a great mass of unpublished material for valuable final reports which will now probably never see the light; all this was

[1] AMERICAN NATURALIST, May, 1879, p. 343, August number, p. 535.

not only interrupted, but stopped, through the unwise action of a handful, not of politicians, but scientists. The result has proved, we fear, that it would have been better to have let well enough alone, for during the past season little or no geological exploration has been carried on in the Western Territories; small parties were sent to Leadville and the Eureka mines and the Comstock lodes and the California gold fields, no general geological work having, apparently, been done at all! The people want and are expending money for more information about the unsurveyed lands of the Far West; the scientific world demand and should have widely extended and thorough topographical, geological and biological surveys of that vast region, such as have been inaugurated and carried on in the past; these, as we have always felt should be directed by one mind, and for this reason some members of the National Academy voted for the consolidation of the different surveys then in the field. For a United States Survey of the Public Lands to expend a large or moderate proportion of its money and means in one or several of the Eastern States, such as Tennessee, or one of the New England States, is absurd and uncalled for, and interferes with the work that may be going on or is in prospect in such State. American scientists hope and expect that geological explorations under the new *regime* will, hereafter at least, not be inferior in breadth of treatment, scientific accuracy and extent, to what it has been in the past; certainly that the zeal and previous success in field and general geological work of the Geologist of the Fortieth Parallel may not be lessened, but fulfill the expectations of the American people and scientific public.—*Editors Naturalist.*

— Prof. B. F. Mudge, formerly Mayor of Lynn, Mass., died in Kansas on Friday last. Mr. Mudge was born at Orringford, Me., August 11, 1817; his parents removed to Lynn when he was about a year old. He attended the common schools until he was 14 years old, when he went to work at shoemaking, at which he worked six years. Then fitting for college he entered Wesleyan University, where he graduated in 1840, subsequently taking up the study of law. In 1842 he was admitted to the bar and practiced his profession at Lynn until 1859. He was elected the second mayor of Lynn, serving in 1852 and 1853. He went West and became chemist for the Breckinridge Oil and Iron Company of Kentucky. When the war broke out he went to Kansas, and in 1863 was appointed State Geologist. In 1865 he was elected Professor of Geology and Associated Sciences at the State Agricultural College, and remained in that position for eight years. Since 1874 Mr. Mudge has been employed in exploring the geological formations of Western Kansas. He was also employed by Dr. Hayden in describing the tertiary and cretaceous formations in Kansas, and he made extensive collections for Prof. E. D. Cope, in that State, during which he discovered the first specimens of

toothed birds. Prof. Mudge spent the greater part of his later years in camp life beyond the settlements in the employ of Prof. Marsh as field geologist for Yale College. He was a member of the American Association for the Advancement of Science, and of other scientific bodies, and was instrumental in founding the Kansas Academy of Sciences, of which he was the first president. In 1876 the office of State Superintendent of Public Institutions was offered him, but he preferred to continue his field work. In 1846 Mr. Mudge married Miss Mary E. A. Beckford, of Lynn. Six children were born to them, of whom three are still living.

— During his voyage near Behring Straits, Professor Nordenskiöld obtained numerous remains of Steller's manatee, of which only a few bones have hitherto existed in the St. Petersburg Museum. This large Sirenian, it will be remembered, became extinct in 1786.

— The death of A. H. Garrod, F.R.S., Oct. 17th, at the age of thirty-four, is announced in the English papers. He was making an excellent reputation as a comparative anatomist and physiologist.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

KANSAS ACADEMY OF SCIENCES, Twelfth Annual Meeting.—Prof. B. F. Mudge, the president of the academy, lectured on the mound-builders of America. Papers were read by the president on the metamorphic deposits in Woodson county, and on Indian mounds in Davis and Riley counties, also by Dr. A. H. Thompson on Indian graves near Topeka. The report of the Commission on Botany was read by Prof. J. H. Carruth, who announced the discovery of about 120 species new to the State. A paper was read by Hon. F. G. Adams, of Topeka, on the phonetic representation of the Indian language, describing the systems or alphabets invented by the Cherokee, Sequoyah, and by Mr. Meeker, a missionary who formerly resided in Johnson county. The alphabet formed by Mr. Meeker was said to be adequate to the perfect phonetic representation of any Indian language, and books were printed in the characters of that alphabet in eleven different dialects.

BOSTON SOCIETY OF NATURAL HISTORY, Nov. 5th.—Mr. W. O. Crosby spoke on the Evidences of Compression in the Rocks of the Boston basin, and Mr. J. W. Feukes on *Abyla pentagona*, and its relation to a theory of bilateral symmetry. Nov. 19th.—Mr. Ernest Ingersoll read a brief survey of the native oysters of Massachusetts. Prof. A. Hyatt spoke on some remarkable changes undergone by fresh water snails (*Lymnæa megasoma*) in captivity, as observed by Mr. A. P. Whitfield. Dec. 3d—Mr. J. S. Diller remarked on the felsites and their associated rocks north of Boston.

APPALACHIAN MOUNTAIN CLUB, Nov. 12.—The councillors reported as follows: Mr. J. R. Edwards on topography, Prof. C. E. Fay on exploration and Dr. W. B. Parker on improvements. Rev. John Worcester described the excursion to Tuckerman's ravine, made in connection with the field meeting at North Conway. Prof. Charles R. Cross gave an account of the Congress of Alpine clubs, held at Geneva the past summer, which he attended as the representative of the club.

Dec. 10.—Prof. J. H. H. Huntington reported as councillor of natural history. Mrs. Phebe M. Kendal presented her report as councillor of art. Prof. E. S. Morse read some notes on Japan, illustrated by the large maps of Japan recently received by the club. A copy of Prof. Guyot's new map of the Catskill mountains, presented by the author, was shown and an explanatory paper, written by him, was read.

AMERICAN GEOGRAPHICAL SOCIETY, Nov. 18.—The Earl of Dunraven read a paper on moose and caribou hunting in the wilds of Canada. Dec 9.—Rear Admiral Ammen presented a paper on the proposed inter-oceanic ship canal across Nicaragua.

NEW YORK ACADEMY OF SCIENCES, Section of Biology, Dec. 1.—Prof. Geo. Macloskie read a paper on the proboscis of the house fly.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

AMERICAN JOURNAL OF SCIENCE AND ARTS, Dec. 15th—Artificial fertilization of oyster eggs, and embryology of the American oyster, by W. K. Brooks. Origin of the Lœss, by G. C. Brodhead. New Jurassic reptiles by O. C. Marsh.

GEOLOGICAL MAGAZINE, Nov.—Further notes upon the form of volcanoes, by J. Milne.

JENAISCHE ZEITSCHRIFT FÜR NATURWISSENSCHAFT, Oct. 29—On the comparative anatomy of the digestive system of birds, second part, by H. Gadow. The distribution of the fresh and brackish water fishes of Africa, by C. Dambeck. The anatomy and histology of the actinians with special reference to the nervo-muscular system, by O. and R. Hertwig.

SIEBOLD UND KÖLLIKER'S ZEITSCHRIFT FÜR WISSENSCHAFTLICHE ZOOLOGIE, Oct. 29th—Researches on the structure and development of sponges, eighth part, by F. E. Schultze. Germ layers and formation of the organs of Echini, by E. Selenka. Contributions to the natural history of the *Daphnidæ*, by A. Weismann.

ANNALES DES SCIENCES NATURELLES, Sept., 1878 (just received)—On the scales of teleosaurian fishes, by M. Carlet. On the geographical distribution of bats compared with that of other terrestrial mammals, by M. Trouessart.

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OBSERVATIONS UPON THE HABITS, STRUCTURE AND DEVELOPMENT OF AMPHIOXUS LANCEOLATUS.

BY HENRY J. RICE.

[*Concluded from the January number.*]

Nervous System.—This system consists of a central and a peripheral portion. The central portion, or *chorda spinalis*, is a long, slender, slightly tapering body, nearly round in section, and extends from the posterior to within a short distance of the anterior extremity of the dorsal aspect of the notochord. The anterior end is somewhat larger, for a short distance, than the rest of the chorda, and forms a sort of elongated head with a short, pointed, beak-like termination, which lies close upon the notochord. Upon the left side of this "head," and near the end or anterior portion, there is a slight cone-like projection, which is in close proximity to and points towards the ciliated pit or depression of the left side of the body. This projection is considered to represent a single olfactory nerve or lobe, and if the pit is indeed a nasal fosse, then undoubtedly this protuberance is an olfactory organ. With the exception of this nerve or lobe this end of the chorda does not present the slightest indication of the divisions or lobes which form the brain of all other vertebrates.

The posterior extremity of the chorda makes a short upward bend, at nearly right angles to its former direction, and expands just above the end of the notochord, into a small, button-like termination, which probably through some accident in finishing the plate, is not shown in the figure of the adult animal. Between the two ends and along the center of the chorda there extends a narrow canal, which is of considerable size in the head portion, where it is enclosed by the anterior walls, but gradually diminishes in calibre towards the posterior extremity, where it is represented by

the merest traces of a cleft or opening, as seen in the center of the "button" of this end.

The sides of this canal, throughout its entire length, are marked by small, black, roundish pigment spots, which are sometimes aggregated into small clusters, but more commonly are scattered along at varying intervals from each other. In the substance of the anterior, beak-like extremity, and just in front of the end of the central canal, there is a large pigment spot which is generally thought to represent the rudiments of a median eye; but if it does not, then Amphioxus is entirely lacking in such an organ. Prof. Quatrefages, in 1845,[1] described and figured a prominent protuberance as existing upon the side of the cord at this end, and claimed that it showed at its extremity a distinct and rather well-developed crystalline lens, thus representing a stalked eye, with the staik pointing towards the anterior extremity of the body; but later observers have failed to confirm his observations in this respect, the only short protuberance which is formed along this portion being considered as representing, as already mentioned, an olfactory rather than an optic organ.

The peripheral portion of the nervous system consists of a succession of pairs of nerves given off from the upper part of the sides of the chorda dorsalis along its entire length. They originate in single roots, and arise at intervals corresponding to the divisions between each two of the muscle plates. With the exception of the first and last pairs, all the nerves are of nearly uniform size, and, with the same exceptions, they pass outward and downward branching two or three times in their course, to be distributed along the middle and lower portions of the sides of the body. Besides the lower branches, each of these nerves sends off, at a short distance from its origin, a branch which proceeds upwards to the dorsum of the animal, Fig. 6, Pl. II. The nerves, which form the first pair, arise anterior to the body muscles and from the anterior portion of the head of the chorda. They are quite large at their bases, and extend straight forward from the sides of the chorda towards the anterior end of the body, dividing in their course into a large number of branches which are distributed above and below, and all about the extremity of the notochord. These branches terminate, or at least many of them do, in the cells of the exoderm, or else in small bell-like knobs which are wedged in among the exodermic cells, and resemble them very

[1] Annales des Sciences Naturelles, 3me série, Zoologie. Tome 4me, pp. 197–248, pls. 10–13, 8vo Paris, 1845.

much in shape and appearance. The last pair of nerves which arise at some distance from the end of the chorda, are directed backwards and perform the same offices for the posterior end of the notochord and the tail, that the first pair do for the opposite extremity, but the nerves themselves are not so large, being slightly larger than the ordinary body nerves, and they do not divide into nearly as many branches.

Muscular System.—The muscular system may be considered as made up of two sets of body muscles; two sets of transverse abdominal muscles; few or many longitudinal fibres in and along the abdominal walls; mouth muscles; pharyngeal ring muscles, and sphincters for the mouth, branchiopore and perhaps for the ring or neck of the pharynx.

The *body muscles* are disposed as in ordinary fishes, one set upon either side and each set is composed of a series of regular, overlapping muscle plates, which extend from near the anterior extremity of the chorda dorsalis to within a short distance of its posterior termination. Along the entire length of their dorsal half, the two sets are either united or very closely approximated, and enclose the greater portion of the entire length of the chorda and of the notochord, but leave the extremities of both entirely bare of muscular covering (Fig. 1, Pl. 1). These muscles are also united along the ventral edge of the tail portion, but for the anterior two-thirds or more of their length their ventral edges are quite widely separated, spreading outward and downward from the notochord to form the upper portion of the parietes of the abdomen. The general outline of these combined plates, when seen from the side, is that of a long, slender spindle, gradually tapering from the center to a sharply pointed termination at either end. Each plate is composed of longitudinal, striped, muscular fibres, and is four-sided in outline, but with the greater diameter changing in direction according to the position of the individual plate along the side of the body. Those plates which are near either end are nearly rhomboidal in outline, long and narrow, and with the longer points coincident in direction with the notochord. Nearer the center of the body the plates are almost square, the diameters being nearly equal; while along the middle third, where they become once more rhomboidal, or nearly so, the longer diameter is at right angles to the notochord, with the longer portion of each plate running down into the abdominal walls. On account of the overlapping of each plate by the one immediately posterior to it, this fou

sidedness can be seen only in the last plate, which is entirely uncovered. These muscles give to the body whatsoever of color it may possess, and probably also its metallic iridescence, although this latter feature may be due to the striæ and fibres which exist in the integument. These muscles, from their very great extent as compared with the entire body, also give Amphioxus its remarkable power and activity in the sand and water, and from their similarity of arrangement at either extremity, enable, or rather compel it to move with that beautiful, elastic, line-of-beauty motion which is such an interesting feature of its progress. The *transverse muscles* lie in the walls of the abdomen and extend from the ventral edges of the muscle plates of either side to meet and unite in a raphe upon the median ventral line of the branchial sack. These muscles are nearly transparent in structure, and by their action serve to close the sack walls upon or towards the pharynx, as in the expulsion of water from the branchium by the branchiopore, and as is seen in all hardened or preserved specimens. The *longitudinal abdominal muscles*, which are found chiefly in the lower and posterior portion of the abdomen, probably assist in the contraction of the abdominal walls, and also serve to shorten the sack and open the branchiopore. The *mouth muscles*, arranged in the walls of the buccal cavity and attached to the mouth ring and its appendages, serve to open the mouth, and by this operation unclose the overlapping oral tentacles. It has been said that besides these general muscles there are special muscles which serve to move each individual tentacle separate from the entire circlet. I have never seen any evidence of any such muscles, and never, in a single instance any individual motion of the tentacles, and if such muscles exist their action must be very feeble or entirely nugatory. The *muscles* of the *pharyngeal ring* are situated in the posterior portion of the buccal cavity and attached to the borders of the ring so as to bring the tentacles of these parts forward across the mouth of the pharynx. The *sphincter muscles* surround their respective orifices and serve, as in the case of all sphincters, to approximate the edges of these different apertures. There may be a rudimentary sphincter to the anus, but neither in the young nor the adult have I ever observed what may be strictly called a closure of this orifice.

Reproductive Organs.—These organs consist of a number of roundish or oval bodies formed inside the lining membrane of the walls of the branchium and attached to the ventral edges of the

muscle plates in a single row, along either side of the animal. Each body consists of a case or capsule enclosing a central solid portion or matrix, within which are developed the generative products, and each case is placed with the center of its upper border in juxtaposition to the line of overlapping or junction of two of the muscle plates (Fig. 6 *a*, Pl. II). Ordinarily these cases are small and inconspicuous, and lie entirely below the outline of the body muscles, but in the female, towards the breeding season, the ova increase so much in size that the cases become large and noticeable, closely pressed together, and extend for about a quarter or third of their diameter above the edge of the muscles to which they are attached, thus occupying a goodly share of the sides of the branchium. In the female which was in my possession there were twenty-six of these cases upon each side, extending from a little in front of the middle of the pharynx back to very near the branchiopore. In the males there were respectively twenty-three and twenty-five pairs of cases so that it is probable that there is no great difference in the number of pairs of cases in the two sexes. These generative organs are without outlets, the germinal products escaping from them, when fully ripe, by the dehiscence or bursting of the walls of the capsule and the lining membrane of the cavity, and thus get into the branchium from whence they pass into the surrounding water, the spermatozoa to come in contact with and impregnate the ova, and the ova to develop into young animals.

This escape from the body is probably effected during the feeding time of the animals, when there is a current more or less strong passing through the branchium. The exact method by which the ova become impregnated is not known, but it may be supposed that the spermatozoa, after passing from the male, move about in the water until swallowed by a feeding female, when they pass into the branchium with the greater quantity of the water, and so get to the cases containing the ova, penetrate the capsules, or more likely adhere to the exterior until the ova are extruded, and then effect the work of impregnation. Any ova which were in the branchium at the time of the entrance of the spermatozoa, and which had been recently separated from the cases, would of course be very quickly fastened upon and impregnated.[1] Each ovary, if a single case may be considered to represent an ovary, contains from twenty-five to thirty ova, and each ovum is enclosed

[1] It is possible that it may be shown hereafter that the ova are impregnated only after they pass from the female into the surrounding water, there meeting the floating spermatozoa which have been discharged from the male.

in a separate membrane or cell, any one of which may open and discharge its contents without affecting the rest of the case. Under the microscope these cases appear like small bags of marbles or bunches of grapes, except that most of the ova show a lighter, roundish spot near the center, which represents a nucleus, the nucleolus not being visible (Fig. 4, Pl. II). After escaping from the cases and becoming free in the branchium, the ova in all probability, pass out of the body, by way of the branchiopore, in the water which is being constantly expelled from this orifice during the process of feeding. Up to 1873 this was considered, by careful observers to be the only method by which the ova could possibly escape into the surrounding medium, and Quatrefages says that he saw them, under the microscope, pass from this aperture. But Kowalevsky, in his paper upon the development of Amphioxus,[1] says that *he* saw the eggs issue from the *mouth* of the female in bunches of fifteen or twenty, and hence concludes that they are normally extruded from this opening. This abnormal proceeding on the part of Amphioxus has been questioned by Wm. Müller[2] on the grounds that the branchial slits are too narrow to admit of the passage of the ova in this direction, and Prof. Huxley seems to be of the opinion[3] that if this proceeding took place as described by Kowalevsky, that it was accidental, and due to some of the ova in passing out by the branchiopore getting caught in the openings of the lateral folds, being carried along the hollows of these folds and discharged at their anterior openings into the mouth cavity and thence out of the body. But this would not account for their issuing in bunches of fifteen or twenty, and moreover, as there are no such openings to the metapleura (ante p. 6), the ova could not have passed in this direction. Prof. Ray Lankester[4] sides with Kowalevsky, and says that in all probability the ova *do* pass from the mouth, but if not by the branchial slits, then by certain openings which exist, one upon either side, and connect the branchium with the buccal cavity. This connection has not been noticed by previous observers, although Prof. Lankester thinks that these openings are the ones

[1] Entwicklungsgeschichte des *Amphioxus lanceolatus*. Von Dr. A. Kowalevsky, Mem. de l'Acad. Imp. des Sciences de St. Petersbourg, VIIme série. Tome XI, No. 4, p. 1. St. Petersburg, 1867.

[2] Ueber das Urogenital system des Amphioxus, &c. Jenaische Zeitschrift, Vol. IX, p. 94. 1875.

[3] Classification of the Animal Kingdom. Prof. T. H. Huxley. Quar. Jour. Microscop. Sci., Vol. 15, p. 54. 1875.

[4] Loc. cit., p. 263.

figured by Joh. Müller[5] and considered by him to be the anterior openings of the meta-pleura. In the case of the female which was in my possession, the ova were extruded very gradually and for the most part one by one, so that here and there along the row of cases could be seen, one with a single ovum gone, others, nearer the ends, half empty, and still others, near the middle, with their full quota. During this period, which extended over the entire time the animal remained alive, I was not fortunate enough to see any ova leave the body, but from the size of the branchial slits, the position of the generative bodies, and the actions of the cilia, currents and abdominal walls, which I studied with considerable care, I arrived at the conclusion, which is in accordance with the opinions of Wm. Müller, Quatrefages, &c., that, the ova all passed from the body by the branchiopore, and that while not absolutely impossible, it would be an exceedingly exceptional proceeding if any should pass out by way of the mouth. I found that seven ova placed side by side extended over a space just equal in length to the breadth of five branchial slits with their enclosing arches, and as the bars of the arches are quite as broad as the slits, the ova in passing out in this direction would be obliged to pass in opposition to the powerful action of the branchial cilia and inflowing water, through openings which at most would be only seven-elevenths as broad as the diameter of a single ovum, which would be an exceedingly difficult performance. If the openings mentioned by Prof. Lankester exist, and are no broader than the breadth of the branchial slits, there would be the same difficulty in passing through them as in forcing a way through the slits, besides having to traverse nearly half the length of the pharynx against the current of water and the pressure of the abdominal walls. If these openings are larger than the openings of the slits, it would hardly seem possible that they could have remained undetected until this late date, but even in this case the passage of ova through them could hardly be more than an occasional and chance occurrence, since the same obstacles exist to the passage of the ova forward to these openings as in the case of the smaller ones, and are even increased by the liability of currents of water setting through them into the branchium and thus assisting in expelling the ova

[5] Ueber den Bau und die Lebenserscheinungen des *Branchiostoma lubricum.* Von Joh. Müller. Abhandlungen der Berliner Akad. Berlin, 1842 (1844), Pl. III, Fig. 4, *c*.

by the branchiopore. Thus in any case there would be great difficulty for the ova to get *into* the mouth cavity, and when once in they would be fully as liable to be drawn down through the pharynx into the stomach as to be expelled from the body. But it seems to me that it is not necessary to suppose any such difficult and abnormal passage, as it appears possible to harmonize, in a natural manner, the opposing views of Kowalevsky with those of Quatrefages and Wm. Müller, for *apparently* the ova *may* proceed from the mouth, while *actually* they make their exit from the branchiopore. When we consider the position of Amphioxus during feeding time, that is, when it comes to the surface of the sand, we find that it has formed for itself a sort of sand tube in which it lies, belly upwards, with its mouth orifice, or a small portion of its body exposed to view, as it was when Kowalevsky saw the ova issue. Now at every contraction of the abdominal walls there will be left a space between the body and sand, extending from the branchiopore to the mouth, or near it, through which the water expelled from the branchium may pass to and mingle with the water above the sand. And if at this time the ova are extruded from the pore along with the water, they will naturally rise to the surface of the sand, pass along by the mouth tentacles, *appearing* to any but the most careful observation *to come from between them*, and so into the medium where they float about until transformed into young Amphioxi. If this is the true method of procedure, as it is the most simple and natural, it will account, *as no other method will*, for the little bunches of fifteen or twenty which Kowalevsky saw emerge into the water. For in passing from the pore out against the sand it would be very easy for some of the ova to become lodged against the sides of the tube until a number of them accumulating together would form an obstacle of sufficient importance to be forced out by the outflowing water, and sent along by the tentacles, when they would be seen rising in the water as if just escaped from the mouth cavity.

The Urinary System.—The earlier anatomists who examined Amphioxus were unable to discover any organ, or series of organs, which could be considered as acting as specialized excretory vessels for the urinary products, and for quite a time it was a matter of considerable speculation as to the method by which these products, if any were formed, were eliminated from the body. Very soon, however, certain isolated, ductless, glandular patches were

discovered to exist upon the floor of the posterior portion of the branchium near the branchiopore, and as no other function could be thought of as being performed by them, and as there were, apparently, no other organs which might subserve the purposes of excretion, it was supposed that these patches acted in this capacity, and after eliminating the urinary products cast them into the branchium to be extruded from the body through the branchiopore with the water which passed from this orifice.

This opinion, which might be considered as very plausible, since the patches were associated in position with the posterior generative bodies, was very generally held until quite recently, but in the paper by Prof. Lankester, already referred to, he announces the discovery of certain canals which he considers as representing, rather than these patches, the true urinary ducts of Amphioxus. These vessels, one upon either side, are in the form of long tubular ridges, formed along the roof of the pleuro-peritoneal portion of the branchium as outgrowths from the meso-derm of the body walls. They are composed of pigmented cells and their posterior extremities are open and communicate with the branchium near the branchiopore, but their anterior extremi-ties, which are in the neighborhood of the sides of the pharynx, are probably closed. These canals are thus apparently homolo-gous with the earlier stages at least of the ducts of the uriniferous tubules of other vertebrates, and unless further investigation shows them to appertain unmistakably to some other system they will undoubtedly henceforth be considered as representing, as Prof. Lankester suggests, the urinary system of this animal.

The Blood Vessels.—The general arrangement of the vessels of the blood system in Amphioxus is very similar to that found in the young of all osseous fishes, but in the minutiæ of the plan there are quite important modifications, which, although not making a complicated system, yet render it very different from any other known among vertebrates. The main blood vessel, or vein, extends from the anus along the ventral aspect of the intes-tine to the base of the saccular liver, thence around the entire length of this organ upon both ventral and dorsal edges, to con-tinue along the ventral aspect of the œsophagus and pharynx to a point just beneath the first branchial cleft where it expands or merges into a bulbous organ, the heart. This canal is pulsatile, and has been given different names according to the section of

the body through which it passes, but it is undoubtedly to be considered as a single vessel, since it is of nearly uniform calibre throughout its course, and the rythmical contractions, which are a very marked feature and readily seen, especially in the young, pass from behind forwards, at somewhat lengthy intervals, along its entire length. Up to quite recently this long tubular vena cava was considered to be the sole pulsatile organ of Amphioxus, and as a "tubular heart," which was the term applied to it, was an anomaly among vertebrates, it was thought fit to designate the "thin" from the "thick" hearted vertebrata, and thus separate Amphioxus from the rest of the family by instituting for its sole reception the class Leptocardia. But in 1876 Langerhans announced[1] the discovery of the organ, which is described above, as being situated at the anterior extremity of the vena cava, and which he considers as representing the heart. If this is the case, and Amphioxus does indeed possess a thick-walled pulsatile cavity, the above classification may have to be revised, but even then the pulsatile character of the vena cava, together with the other peculiarities in the organization of Amphioxus, may be considered of sufficient importance to make it the unique representative of a distinct class. From each side of the pharyngeal portion of the vena cava a series of vessels are given off, which correspond in number and position to the main bars of the branchial arches, and through which these vessels pass to the dorsal edge of the pharynx, where they unite into two aortæ, which run back without any intercommunication, one upon either side of the median line, to the œsophagus, where they unite into a single tube, which proceeds as a distributing vessel to the end of the body. Each series of these branchial or blood-renovating vessels forms its own aorta, and each individual vessel has, at its base or origin, a small dilatation or bulb-like enlargement to which the name of "branchial heart" has been given. These "hearts" lie in the alternating triangular spaces between the curved bases of the cartilaginous arches, *a*, Fig. 4, Pl. 1, and probably act as elastic reservoirs to render the flow of blood steady and continuous through the branchiæ. The main heart, into which a certain, perhaps a large proportion of blood from the vena cava passes, gives off three vessels, two small ones from its anterior border,

[1] Zur Anatomie des *Amphioxus lanceolatus*. Von Dr. Paul Langerhans. Archiv für Mikrokopische Anatomie. Band 12, p. 336, fig. 49*c*. Bonn, 1876.

and a large one from its left side. The anterior vessels proceed to and supply the walls of the buccal cavity and the tentacles, and the left branch, which forms the ductus Botalli, or aortic arc, passes across the pharynx between the pharyngeal ring and the anterior branchial clefts, to unite with the left aorta, formed by the union of the left branchial vessels, and by this route sends its blood into the main arterial channel.

The blood of Amphioxus is colorless, containing only white nucleated corpuscles,[1] and very few of these. The manner, however, of its distribution from the aorta and branches of the heart to the different parts of the body and its return to the vena cava and heart is not at present known. It may be that the passage is effected by means of capillary vessels which are so minute that they have not as yet been made out, or it may be, and which is much more probable, that this fluid passes through the interspaces between the various tissues, or in other words, that the large blood vessels terminate as blood sinuses.

Development.—For those changes which take place in the embryo of Amphioxus previous to the formation of the side folds, and for most of my information in regard to the growth of these folds, I am chiefly indebted to the investigations of Kowalevsky[2] who has shown that shortly after the impregnated ovum leaves the branchium of the female and passes into the surrounding water, the granular vitellus, which nearly fills the rather delicate vitelline membrane, undergoes complete segmentation and gradually builds up a thin-walled, nearly spherical morula, which soon, under the energetic action of the numerous external vibratile cilia, each cell of the wall being furnished with one or more of these little lashes, begins rolling over and over, quite slowly, within the enclosing membrane, agreeing in this respect with what is seen in the ova of certain other vertebrates and many of the invertebrata. After the commencement of these rotary movements, or it may be before they begin, the morula becomes transformed, by the introversion of one side and the subsequent near approximation of the edges of the cup thus produced, into a gastrula, and the gastrula, by the elongation of its

[1] Examination of the corpuscles of the blood of *Amphioxus lanceolatus.* Prof. T. H. Huxley. Report of Brit. Ass. of Science. London, 1847. Report of sections. p. 95.

[2] Loc. cit. and Weitere Studien über die entwickelungsgeschichte des *Amphioxus lanceolatus.* Archiv. für Mik. Anatomie, XIII, p. 181. Bonn, 1877.

sides in the direction of the axis which passes through the gastrula mouth, or blastopore, changes into a slender, compressed, double-walled, planula-like body, ciliated within and without, and with the two walls, or exoderm and endoderm layers, which surround the rather large central cavity of invagination, lying close together one within the other, but separated by a narrow space which represents the remains of the original segmentation cavity of the morula. By the time the embryo is well established in its planula form, the blastopore, which marks the posterior extremity of the body, closes up entirely, or at least it is highly probable that it does, and the young Amphioxus escapes from its shell and becomes a free swimming inhabitant of the water. The cells of the exoderm and endoderm, along one edge of the embryo, now become longer and larger, entirely obliterating in their growth the segmentation cavity in this part of the body, and form between them, throughout the length of the animal, a strip of mesoderm in the center of which arises the notochord and from the sides of which originate the muscle plates of the body muscles. As the mesoderm thickens, two longitudinal ridges grow up from the exoderm and, arching over, unite upon the median line into a dorsal tube which runs parallel with and close above the notochord. Within this tube the central portion of the nervous system is formed. This arises as a second tube lining the walls of the first, and originates from the differentiation of the exoderm cells of the latter. During its formation the ends of the dorsal canal have been gradually closing up, one of them, the posterior, completely, and the other, the anterior, all except a narrow outlet which persists until a somewhat later stage of development.

Meanwhile the whole body lengthens; the exoderm of the ends stretches away from the endoderm into thin blade-like points; the central cavity, limited by the transformation of the dorsum to the lower half of the body, becomes long and tube-like posteriorly, and quite broad throughout its anterior third; a welt or pear-shaped body, with the narrow end pointing downwards, forms across the anterior end of this broad pharyngeal portion of the central cavity, and the external cilia, which heretofore have been the sole motive power, supplanted in their functions by the muscular fibres of the mesoderm, disappear, except upon a small depressed pit-like bit of surface situated upon the

left side of the anterior end, a short distance back from the extreme point of the body. The middle part of the tubular portion of the central cavity now enlarges into a small oblong stomach, with obliquely-placed cilia along its walls, and openings, formed by ingrowths of cells from the exoderm, appear upon the left side of the body, one at either end, placing the central cavity in communication with the exterior. The posterior of these openings is formed at the very extremity of the cavity, at the base of the exodermic tail expansion, and at or near the point of closure of the blastopore, and it may be that it is rather a reopening of the old gastrula mouth than a new formation, although the latter seems to be the opinion at present.[1] It is small, slightly dilatable, and becomes the anal aperture of the intestine. The anterior opening penetrates the body wall along the anterior half of the pharyngeal portion of the cavity and becomes the mouth orifice. It is at first a short longitudinal slit, but soon broadens into an oval aperture of considerable size, with long, slender, alternating, teeth-like processes extending out from the edges towards the center as guards to the entrance, and a thickening of the body wall takes place just below it, forming a prominent ridge-like border extending from near the median line below the cartilaginous, pear-shaped welt, backwards and upwards to very nearly the level of the notochord. Along the inner, lower edge of this mouth-ridge there are generally two or three slender pointed processes which lie close to the body and point towards the right side. The central cavity is thus at once transformed into a digestive tract, the food particles being drawn in at the mouth by the action of the internal cilia, passed on to the stomach, where they are twisted and ground up for the nutrition of the animal, and the refuse material sent onward to the anus and so out of the body.

A third opening now makes its appearance, piercing the body wall upon the median ventral line just below the mouth orifice. It is somewhat larger than the anal opening, longer than broad, with the longer diameter transverse to the length of the body, and forms the first of a series of ten or eleven similar pharyngeal clefts which open along the under side of the pharynx at regular distances back to very near the middle of the body. Coincident with the formation of this first pharyngeal cleft, two delicate

[1] Early stages in the development of Vertebrates. F. M. Balfour. Quar. Jour. Mic. Science. Vol. xv, p. 208. Camb., 1875.

longitudinal folds arise from the exoderm along either side of the entire length of the upper portion of the central cavity, and grow outward and downward toward the ventral aspect of the body. They soon attain a level with the lower edge of the intestine, which, as already mentioned, is much narrower than the pharyngeal section, and those portions of the folds which lie along the intestine closely embrace it as a sort of tubular outer coating, and unite along their edges into a broad median ridge which extends from the anus, where it merges into the exodermic tail expansion, to a point just in front of the stomachic dilatation. This ridge forms the ventral extension of the continuous ventro-dorsal median fin.

The anterior portions of the folds now increase in breadth, leaving quite a space, the rudiments of the branchium, between their edges and the alimentary tract, and gradually unite but with a smooth, unridged surface, along the median line forward toward their anterior extremities. In this union an opening is left between the edges of the folds just at the point where they leave the anterior edge of the coalesced ventral ridge; this opening, which forms a means of communication between the cavity enclosed by the folds and the exterior, represents the abdominal pore, or branchiopore. It will thus be seen that the abdominal portion of the animal presents two widely different sections; the one, posterior, with firm walls, closely surrounding the intestine and stomach, and with a very restricted cavity enclosed between the body walls and this portion of the digestive apparatus; and the other, anterior, with thin dilatable walls, which are at some distance from the alimentary tract and which enclose quite an extensive cavity or space, which communicates directly with the exterior and with the cavity of the posterior section. It may be that these two sections are somewhat more complicated in their formation than I have indicated above, that while the posterior portion is fashioned as already mentioned, the walls of the anterior cavity are formed by the outgrowth of new folds from the inner edges of the old ones; that is, that after the coalescence of the posterior portions of the first folds around the intestine, these folds grow no further, but a new set originate from the inner anterior borders of the first, and by the extension and subsequent union of these more delicate laminæ, the walls of the anterior cavity are formed. The peculiar pit-like character of the bran-

chioporic depression would seem to indicate some such development, and in this case the lateral abdominal folds, the metapleura of the adult, would represent the external edges of the first pair of reduplications. This point will, however, be rather difficult to ascertain, and I am obliged to say that in none of my young specimens did I see any direct evidence of any such secondary growths, the development appearing to be as first described, so that I shall continue to consider the cavities as formed only of two folds. In whichever manner, however, they are formed, the one slender and of little account, being barely discernible, the other large and of great importance in the animal's economy, they are both lined, from the nature of their formation, with a continuous layer of exoderm, that upon the external walls of the cavities being derived by cell multiplication directly from that which covers the inner walls. At this period the right fold extends forward as far as the edge of the cartilaginous welt, where it merges into the exoderm, the left, as yet, only to and uniting with the edge of the mouth ridge, both being perfectly free from the sides or lower edge of the pharynx, and by the time they have united along their ventral edges to a short distance in front of the branchiopore, two or three additional pharyngeal clefts have formed along the median line of the pharynx, and the animal now appears much as shown in Fig. 7, Pl. II, which represents the youngest of the specimens which came into my possession. Here can be seen the long notochord with the slender, tubular, spinal axis above it; the ciliated pit just in front of the pear-shaped welt; the side mouth with its teeth or tentacles; the cilia lining the alimentary tract; the long œsophagus, the dilatation for the stomach and the asymetrical anus forced to one side by the outgrowth of the exoderm of the tail and the median ridge of the ventral folds; the depression indicating the position of the branchiopore; the three pharyngeal clefts piercing the pharynx beneath the mouth aperture, and the long tubular heart, formed at about this period, between the endoderm and exoderm of the ventral edge of the alimentary tract. The shape of the animal is quite characteristic, very much compressed from side to side and pointed at either extremity, but the posterior end is not often knobbed, as shown in the plate, having generally the shape shown in Fig. 5, Pl. I. The full number of clefts now soon appear along the lower edge of the pharynx between the open edges of the side

folds, and, about the time of the formation of the last cleft, the mouth aperture begins to change its position, moving forward very slowly toward the cartilaginous welt and the ciliated pit. Accompanying this forward movement of the mouth the anterior pharyngeal clefts become pushed over toward the right side of the pharynx, and to a slight extent under the right fold; the posterior part of the ciliated pit grows backward, burrowing into the tissue toward the cartilaginous welt; and the cartilaginous welt broadens throughout its upper portion, the upper posterior limb growing backward towards the mouth, and a slit or opening forms through its center so as to transform it into an irregular pear-shaped ring of cartilage placed obliquely across the anterior portion of the central cavity. Fig. 5, Pl. II, represents a diagrammatic cross-section of the body at this stage of growth. The section is made transversely through the mouth and one of the pharyngeal clefts, as at *a*, Fig. 7, Pl. II. The mouth opening, with its teeth-like processes, is seen upon the right side; the mouth *welt* with *its* processes below it; the pharyngeal cleft pushed just to the left of the median ventral line; and still further to the left a slight indication of the anterior portion of the right body fold. The mouth and pharyngeal apertures open directly into the digestive tract.

The forward movement of the mouth, and the backward movement of the ciliated pit, continue until the anterior edge of the mouth aperture is close to the posterior limb of the cartilaginous ring, and the posterior portion of the ciliated pit has burrowed back to the opening in the ring, when a split takes place in the body wall extending from the mouth opening forward over the the edge of the cartilaginous welt and through into the ciliated pit, Fig. 2, Pl. II, in which only the edge of the ciliated pit is indicated, the central, deeper portion being back towards the central dotted lines of the figure. This split now deepens or extends to the center of the pit, forming a passage-way into the digestive tract through the cartilaginous ring; the mouth aperture and split in the body wall gradually close; the bottom of the ciliated pit becomes attached to the edge of the cartilaginous ring, which is already attached to the walls of the anterior extremity of the pharynx, and the food passes into the digestive tract from this time forward by way of the newly opened aperture in the bottom of the ciliated pit. This is a marked advance in development,

and it is hardly more than accomplished, and perhaps in many instances not completed, before the body folds close up entirely over the pharyngeal clefts, the left body-fold advancing towards the cartilaginous ring coincident with the advance and final disappearance of the pharyngeal mouth aperture and mouth welt; the first two or three pharyngeal clefts become pushed almost entirely over upon the right side of the pharynx; the ciliated mouth cavity enlarges anteriorly, the dorsal and posterior edges growing downward and forward, and small fleshy prolongations appear upon the posterior edge; and two or three small oval openings appear piercing the left side of the pharynx at points intermediate to the already formed pharyngeal openings, in a line just posterior to the cartilaginous ring and beneath the level of the notochord. Fig. 1, Pl. II, shows the appearance of the anterior portion of the animal at this time, with mouth tentacles beginning to show along the posterior edge of the cavity, and the oblong openings along the left side of the pharynx.

These openings in the pharynx represent the rudiments of the left branchial fissures or arches. They increase in size until the first one is about one-half the width of the pharynx, when a small protuberance forms in the center of the upper or dorsal border, and grows downward towards the ventral edge, finally merging with it and dividing the opening into two more or less elongated apertures, the branchial slits or clefts. Before this division is effected however, each of the other openings has given rise to a central prolongation, which grows downward to finally unite with the lower border, as in the first case, and two or three new openings have pierced the pharynx, one between the first arch and the cartilaginous ring, and the other in a line with, and posterior to, those first formed in the pharyngeal wall.

Of these new arches, the first one never becomes divided by a central bar, but each of the others is divided in turn into two sections, as a new opening makes its appearance in the pharyngeal walls. As there appears to be no limit to this formation of arches, and of their division into clefts, in the growth of the individual, there is always to be seen in either young or adult, a posterior round or oval aperture and just anterior to it one or more openings partially segmented by central prolongations, although sometimes the last aperture indicates the central division, by a curvature of the dorsal edge, before the new opening is formed. After

the segmentation of the arches, each bar becomes itself divided, in time, into two halves, or at least marked, as seen in the adult, by a distinct central line of division, Fig. 4, Pl. 1. In all of the arches a circlet of long cilia appear around the inner edge as soon as the aperture is formed, and, with the growth of the central bars, the circlet gradually extends so as in the adult to nearly if not quite curtain each cleft, and when in motion form such admirable strainers for these openings, as has been indicated when speaking of the habits of these animals. The movement of the cilia is wave-like and continuous around the edge of the slit, with the *stress* or *emphasis* of the motion always in the same direction.

In the meantime, while the left branchial arches have been enlarging and dividing, the first three or four pharyngeal openings have attained a counterbalancing position upon the right side, and have, similar to those of the left side, become divided into branchial slits by the downward growth of central bars, and the remaining pharyngeal openings have entirely disappeared, so that at this period both sides are pierced by ten to twelve similar alternating clefts, the first one of the right side being formed like the corresponding one of the left side, after one or two of the old apertures have become divided into clefts, although it is possible that in some instances this first slit may be the first pharyngeal opening, which has remained small and undivided, merely increasing slightly in length in the direction of the breadth of the pharynx, with the general increase in length of the other clefts. The subsequent arches of the right side are of similar formation to those of the left, that is, they are new openings, which are formed through the wall of the pharynx, and in all probability none of them have any relation to the five or six pharyngeal openings which closed up during the changes of the first three or four. Accompanying these modificatiens which take place in the arches, there is an enlargement of the ventral portion of the center of the alimentary tract, and a forward movement of the stomach, so that this organ comes finally to lie within the enlarged anterior cavity of the abdomen, rather than within that portion closely embraced by the side walls.

The enlargement of the alimentary tract is, at first, in the form of a mere swelling-out of one side, accompanied by a pigmentation of the cells of the walls of this section of the tract, but, in a short time a diverticulum, with greenish walls is formed, which

grows forward (Fig. 3, Pl. II), gradually pushes its way along the side of the pharynx (Fig. 3, Pl. I), and becomes the asymetrical liver of the adult.

As the liver passes forward around and along one side of the pharynx, that portion of the ventral tubular vessel of the blood system which passed beneath it becomes stretched out into a peripheral ventral and dorsal vessel for this organ, so that there is, so far as can be made out, no connection between the intestinal and pharyngeal portions of the ventral vessel, except by way of this extension which outlines the liver. In Fig. 5, Pl. I, the liver enlargement is represented at about the time it begins to form, and the ventral vessel is seen to conform to the outline of its lower edge.

A second vessel is also represented, which first appears about this time, extending from the cartilaginous base of the pharynx, between the branchial arches and the pharyngeal ring, upwards and backwards to the ventral aspect of the notochord, where it becomes lost to view. This vessel is the aortic arc or ductus Botalli, and with the exception of this arc and the ventral vessel, with its hepatic continuation and the swellings at the bases of the branchial arches, no portion of the blood system can be made out in the living, young or adult animal. At this period the branchial arches are seven in number upon either side of the pharynx, the third and fourth from the anterior end being largest, and are very broad and well defined, with very large spaces between their broadly pointed bases, and the stomach is seen just over the branchioporic depression, and extends forward into the enlargement caused by the swelling-out of the alimentary tract for the liver cæcum, and in fact this enlargement, and also this section of the alimentary tract after the farther growth of the liver, seems to form a very important part of the stomach, and the swaying, twisting mass of food, with the accompanying oblique arrangement of the cilia, generally extends from the posterior limits of the œsophagus to the beginning of the intestine. The advanced state of the mouth cavity and the tentacles upon the pharyngeal ring will also be noticed in this figure. From the condition as shown in Fig, I, Pl. II, the posterio-dorsal, or left, and the ventral, or right edges of the mouth cavity gradually work downward and forward until the ventral edge nearly coincides with the ventral edges of the anterior portion of the body, by which time this

edge has become lip-like and three or four finger-like prolongations have formed from the exoderm of the lip.

At the same time with the forward growth of the left side wall, the tentacles of the left side have grown longer, increased in number by the addition of one or two prolongations from that portion of the wall of the cavity anterior to those tentacles already formed, and become strengthened by cartilaginous supports formed in the tissue of each tentacle, as tentacular segments, already noticed in the adult, of the left branch of a ring which develops around the edge of the mouth aperture from the base of the cartilaginous ring of the pharynx.

At this period the mouth tentacles have very little share in guarding the mouth cavity from the entrance of large or injurious particles, this duty being delegated almost entirely to the tentacles of the pharyngeal ring, which were formed very soon after the opening of the passage-way through the bottom of the ciliated pit into the pharynx. And while these pharyngeal tentacles are thus of much greater importance to the young than to the adult animal, they are always of service, as has been noticed upon a previous page, in ejecting large bodies which may have succeeded in passing the network formed by the mouth circlet and getting into the mouth cavity. The further development of the mouth cavity is comparatively simple; the left side continues its downward and forward growth, until it is upon a level with the right edge, and the mouth opening becomes a median, ventral aperture just posterior to, and guarded by the rather blunt proboscis of the animal; the right branch of the mouth ring with *its* segments, forms in and along the edge of the right wall, and the cartilaginous supports grow out into the right tentacles; the remaining tentacles, to the number of ten or eleven on either side, making about thirty-one in all, gradually form along the sides, arching inward and forward, so that those of one side overlap and interlace with those of the other, and the mouth cavity assumes its normal adult appearance (Fig. 1, Pl. 1).

By following carefully the development of the mouth cavity of Amphioxus, as I have sketched it in the previous pages, it will be seen to be a true, although somewhat irregular, introversion or inward growth of the exodermic tissue to meet the endoderm of the central canal, and hence is homologous in character with the mouth cavity of the higher vertebrates. It has heretofore

been generally considered that the mouth cavity of Amphioxus was formed by the anterior portions of the side folds overlapping and finally enclosing the anterior end of the pharynx, and by this method of development making the mouth cavity an anterior portion of the cavity surrounding the pharynx. But in none of my specimens could any evidences of any such method of formation be seen, and there are, moreover, certain facts in connection with the formation of the mouth cavity which would seem of themselves to corroborate, to a certain extent at least, my view of the development. First, the mouth being formed upon the left side of the body, has, in the anterior exodermic expansion, a previously-formed right wall, and any extension of the right fold over this portion of the body would only form a third layer over the side and not be of any value in the formation of the cavity, or connect it in any manner with the cavity surrounding the pharynx. Second, the left fold, in order to form the left side of the cavity would have to pass forward over the pharyngeal mouth aperture, and in so doing would so affect the inward flow of food material that this forward growth could be easily observed, provided any such forward growth took place. But the left fold is always limited anteriorly, so far as I have observed, by the mouth welt, and advances towards the cartilaginous ring only as the mouth welt advances towards the edge of the ciliated pit, hence my investigations have led me to the conclusion already mentioned, that the mouth cavity is formed by a true introversion of the exoderm, and is genetically distinct from the branchial cavity. For this reason, combined with the fact that the branchial cavity is essentially branchial in its function, and quite different in its formation from the atrium of some at least[1] of the Tunicates, its walls having more of the nature, in their development, of the gill covers or opercula of osseous fishes,[2] and because it does not

[1] The Anatomy of Invertebrated Animals. By T. H. Huxley. London, 1877, p. 609.

[2] To indicate my meaning as to the homology of the branchium, I would say that if those portions of the side folds, which by their union form the median ventral fin, should be extended forward to a point along the œsophagus, and by their union or coalescense at this point completely cut off the posterior from the anterior cavity; and the ducts of the uriniferous ridges should extend back to the anus, where they could open into a cloaca, and the generative products instead of bursting through the lining of the walls into the branchium, be carried back between the lining and the muscles to the cloaca and there discharged, or in other words, if the pleuro-peritoneal cavities of the roof of the branchium should become more enlarged in the pos-

function as a cloacal chamber, although indeed receiving the urinary and generative products, I have thought it best to give it the name of branchium rather than that of atrium, which is applied to the branchio-cloacal chamber of Tunicates.

The changes which take place in the nervous system while these transformations are taking place in the muscular system and integument, appertain chiefly to the growth and extension of the nerves out into the parts of the body from the chorda spinalis. The chorda itself changes very little in the growth of the animal from what it was in the embryo; the principal difference being that in the adult the central canal has become almost completely filled up, except in the "head," by the thickening of the walls, and the pigment spots are perhaps somewhat larger and more numerous. The posterior extremity is turned up very slightly from a very early period, but it does not exhibit the button-like termination until later in life. The anterior end, or "head," enlarges somewhat in the growth of the animal, so as to represent a very rudimentary brain, and the beak of the "head" and the olfactory nerve attain their adult characteristics probably coincidentally with the outward extension of the peripheral portion of the nervous system, or the general body nerves.

The farther development of Amphioxus has already been indicated in the forward growth of the liver, the multiplication and elongation of the branchial slits, the outgrowth of the ventral cartilaginous processes, forming a base to the ventral median fin, and the extension of the muscle plates down into the body walls.

With these transformations are associated certain changes in external form, particularly in regard to the shape of the two extremities and the appearance of the metapleura of the side folds, and when these are accomplished, the animal has assumed its adult form, as represented in Fig. 1, Pl. 1, and with the development of the generative bodies along the edges of the muscle plates, becomes capable of reproducing its kind.

In conclusion, it may not be unprofitable to summarize, somewhat hastily, those particular features in which Amphioxus dif-

terior portion of the animal, and while extending to the cloaca and opening there, include in their cavities the reproductive organs, then this posterior cavity would represent a true perivisceral cavity or chizocœle. In this case the anterior portion of the folds, forming after the posterior portions, and either from them or in front of them, would be true opercula covering the branchiæ, and it is possible that the growth or formation of the body cavity and opercula in vertebrates has been along some such line of development.

fers from other vertebrates. Beginning with the external characteristics we find a median ventral fin, which is continuous with a long median caudo-dorsal fin, extends for some distance in front of the anal aperture, and which extends quite to the anterior extremity of the body; an anal aperture placed upon the left side of the median line of the body and opening about midway of the side; an abdominal aperture or branchiopore; a longitudinal mouth opening; a circlet of mouth tentacles; and a single asymmetrical nasal pouch. It is very questionable whether the anterior pigment-spot of the spinal cord is of any more value than any of the other pigment spots of the nervous system, hence Amphioxus may be said to absolutely lack both eyes and ears.

Internally we find a saccular liver; and an alimentary tract lined with vibratile cilia. The notochord, besides lacking any anterior cranial expansion, may differ in its structure and mode of development from the notochord of higher vertebrates, but this question is as yet undecided. The remaining organs represent rather embryonic forms of the same organs in higher animals, than different features; thus the spinal cord, with its slight anterior enlargement seems to represent that stage of the central nervous system of higher vertebrates just before the cerebral vesicles are formed; and the blood system, if, as Langerhans claims, there is a heart, and if the blood is distributed throughout the body and returned to the ventral tubular vessel through the spaces in the tissues, rather than through capillary vessels, would be, excepting the position of the heart and the pulsatile character of the vena cava, simply what is seen in all young vertebrates, or at least as seen in the young of osseous fishes, where the course of the blood in the smaller channels is continually changing from one interspace to another, whenever, from any cause, any one channel becomes stopped up, and these changes continue until the capillary vessels are formed. Amphioxus is thus seen to be a *very* peculiar animal, presenting some resemblance to the Tunicates in the ciliated pharynx and pharyngeal tentacles, yet evidently more closely affiliated as an embryonic form, with the great vertebrate branch of the animal kingdom, than with any of the Invertebrata.

A SKETCH OF COMPARATIVE EMBRYOLOGY.

I.—THE HISTORY OF THE GENOBLASTS, AND THE THEORY OF SEX.

BY CHARLES SEDGWICK MINOT.

THE series of articles, of which this is the first, is intended to present in a simple and popular manner, the leading results of the very numerous researches upon the development of animals, published during the last fifteen years. These researches have completely altered the whole science of comparative anatomy and animal morphology, by entirely upsetting a large part of Cuvier's classification and the idea of types upon which it was based, substituting the demonstration of the fundamental identity of plan and structure throughout the animal kingdom from the sponges to man. The details of the observations are already too many for any but the most industrious specialist to become familiar with. We have now entered upon the period of generalizations, which are already so numerous and important that it is impossible to study scientific zoölogy without some knowledge of them. This great progress is still so recent that its results have not been transferred to the text-books, nor even gathered together in any scientific review. Nevertheless, it is possible to compile an outline which may be accepted as fairly correct. This outline it is my present object to trace, with the hope that it may prove at once accurate and useful.

Each branch of the subject will be treated by itself. The illustrations will be taken mainly, if not exclusively, from pen drawings prepared by myself for a work on Comparative Histology, upon which I am engaged. The original source of each figure will be given.

The arrangement of topics will be, first the structure of the egg and spermatozoön; second, the phenomena of impregnation; third, segmentation and the formation of the germ-layers; fourth, the essential features of the embryology of the leading animal types, beginning with the simplest and ascending to the most complicated and highest.

The starting point of comparative embryology, as indeed of nearly all branches of biology, is the cell, composed of the nucleus surrounded by protoplasm. A few years ago the theory was advanced that the nucleus was unnecessary, and various observations were adduced to show that in a considerable number of

living objects there was nothing but protoplasm. In accordance with this view this substance was called the "Physical Basis of Life," under which name it has been much paraded before the public. By a great many persons protoplasm is conceived and described as a "simple mass of jelly." By an easy illogic this phrase of the very ignorant becomes a demonstration that life is a mere property of matter—but that is no matter to us now. What does concern us, is that protoplasm is not a mere simple mass of jelly, but is certainly very complicated, perhaps so complicated that its constitution is beyond the power of human conception. One of the visible indications of the complexity of protoplasm, is, that it is not a continuous substance, but interrupted by vacuoles or cavities, which vary in size, shape and number. These cavities are usually round or oval. The protoplasmatic partitions between them form a complicated network. Sometimes the cavities may fuse together, by a breaking through of the partitions, in which case the network is reduced to a number of connecting threads. The cavities are not empty, but filled with various substances, sometimes liquid, sometimes solid, and differing in chemical composition, as the protoplasm is from one kind of cell or another. For the contents of the vacuoles I propose the name *enclosures.* It will be seen that protoplasm forms only the network which surrounds the other substances. This is an important fact, without knowing which, it is impossible to understand the formation of eggs.

Let us return to the nucleus. It has been asserted that there are numerous animals (*Monera*, etc.) mostly microscopic, which consist solely of protoplasm without any nucleus, and also in some cases that the egg-cell ejects its nucleus, and then it is called a *cytode.* Now it has been shown that a very large proportion of these unnucleated protoplasms (*Protista*) really have a nucleus, and are unicellular animals or plants; therefore it is *probable* that no protoplasm can live without a nucleus, that is to say without being part of a cell.[1] So also with the egg; it has become probable that it never loses its nucleus.

The result of these discoveries is to reëstablish the full importance of the *cell*, as the unit of animal and vegetable organization. Recent investigations by Bütschli (No. 18) and Engelmann upon

[1] The reader must remember, however, that a number of minute organisms exist in which no nucleus has been observed. Future research will decide whether the absence of the nucleus is real or apparent.

the Infusoria have strengthened the movement of return towards the earlier doctrine, which had been for a while crowded aside by the over-hasty advocacy of the protoplasm theory. Bütschli especially has made it extremely probable that all Infusoria are but highly specialized and curiously modified unicellular beings.

It is certainly safe to assume for the present that no life can exist outside of cells, and that all the phenomena of development must be reduced to terms of cell-life. The first point, therefore, to be settled is the relation of the sexual products to the cells from which they are derived, and the multiplication of which they effect. I shall give an hypothesis of these relations, which I have formed, and which is the only one, so far as I am aware, yet proposed. Whether this hypothesis will ultimately prove correct or not, it is impossible to foresee. As it still appears to me plausible, I shall venture to reproduce it here. To explain it, it is necessary to premise brief accounts of the structure of the sexual products (genoblasts) and their development. We will begin with the egg.

The essential part of every egg is developed from a single cell, which undergoes certain modifications, probably nearly the same in all animals, thereby acquiring the definite characteristics which distinguish it as an *egg-cell* from an ordinary cell, and from all other specialized forms of cells.

The eggs of different classes and even species of animals are, as is well known, extremely unlike in appearance. The dissimilarity refers chiefly to size, and to the nature and number of membranes or envelopes by which the egg-cell proper is surrounded by the parent. Thus in the hen's egg, the yolk alone represents the part formed by the egg cell, while the white of the egg and the egg-shell are only secondary envelopes, the former serving to nourish, the latter to protect the yolk, which is the essential part, the true egg.

Now, it is well known that mere size does not enter into the determination of the real affinities of animals and plants. The smallness of the rat does not show that it is related to the frog rather than to the elephant, and from our present point of view the size of eggs is meaningless. The egg-cells are large in all birds and reptiles, in the sharks, rays, ganoids and Cephalopoda, small in mammals, bony fishes and nearly all invertebrates, intermediate in amphibians.

The various envelopes which eggs ever have, may be classed under four categories: *First*, a very thin and delicate one, the proper membrane of the cell itself, which ought always to be distinguished as the vitelline membrane; *second*, the ovarian envelope which is secreted around the egg-cell by the tissues of the ovary; *third*, the envelopes secreted by the oviduct, which may form an envelope of nutritive matter, or a protective shell, or both, as in the hen's egg, of which the nutritive white is secreted by the upper part, the calcareous shell by the middle part of the oviduct; *fourth*, coverings secreted by accessory glands, such as the slime in which the eggs of snails are imbedded, or the shells in which leeches lay their eggs. By adhering to this classification the student will be able to follow with profit the labyrinth of special description. To enter into further details would lead aside from the object of this article: let it suffice to have pointed out the possibility of manifold variations, and to have emphasized the fact that the egg-cell is the important and only essential part of an egg.

The egg-cell always arises from a germ-mass, called *Keimlager* in German. The germ-mass is at first composed of cells all essentially identical in microscopic appearance. Single isolated cells then transform themselves into eggs, while their surrounding fellow-cells play the rôles of nurses and purveyors. To avoid inaccuracy it must be added that in some cases the germ-mass does not consist of distinct cells, but contains numerous nuclei which ultimately become the centers of distinct cells; but before this separation the differentiation of the ova begins. In both methods of development some cells enlarge to form the eggs, others supply the enlarging and growing cells with nutritive material. It is impossible to enter upon this subject further than to say that the form and disposition of nutritive cells varies extremely in different animals, while the changes in the egg are much more uniform, so that it is possible to describe in general terms the development of the ovum.

The modifications which occur in the growing egg-cells are as follows:

1. Change of size: the cell enlarges, it being a rule, no exception to which is, I believe, known, that the mature egg-cell is much larger than any of the other cells in the body of the parent.
2. Change of shape: the cell becomes nearly or quite spherical.

3. The nucleus becomes larger, spherical, and assumes an eccentric position within the cell, while the meshes of the nuclear network are coarse, and few, and for the most part radiate from the nucleolus, which is large, distinct, highly refringent and placed eccentrically within the nucleus.
4. The cellular network becomes very distinct, its interspaces are filled with ovoid or round, solid enclosures, which are usually if not always mainly of an albuminoid character. These enclosures form the part which is called the deutoplasm by Edouard von Beneden and others. The deutoplasm causes the egg-cells to be called the yolk, because it is the nutritive matter from which the protoplasm of the cell grows. The term yolk has no very exact scientific meaning, for it is used to designate sometimes the deutoplasm alone, sometimes the whole egg, as when the segmentation of the yolk is spoken of.
5. A cell membrane appears, and usually acquires considerable thickness.

A typical mature egg-cell is shown in Fig. 1, which represent the ripe ovum of *Toxopneustes lividus*, the common sea-urchin of Europe. The nucleus is proportionately larger than in the eggs of many other animals, its contents are fluid except the net-work and the nucleolus (*n*), which latter frequently has one or more vacuoles. In some cases there are several or many nucleoli, as in osseous fishes, but the meaning of this difference is absolutely unknown. Moreover, this egg is unlike that of many animals in that the yolk spherules or the deutoplasm granules are comparatively small, while in some animals, especially those with larger eggs, the granules are larger. If these variations are borne in mind the figure given may be accepted as a correct representation of a mature egg-cell.

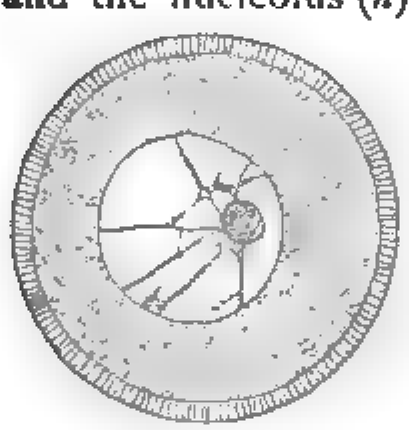

FIG. 1.—Mature ovum of sea-urchin, after O. Hertwig.

I am inclined to think that besides these peculiarities the ripe egg-cell shows a distinction between a thin denser peripheral layer of protoplasm immediately under the vitelline membrane and a central portion, which alone contains deutoplasm, recalling the differentiation of the ectosarc and endosarc in the Amœba. This feature has been observed in several cases, and further research may demonstrate it to be common to all eggs.

The shape of the egg does not necessarily remain spherical, but may be altered by external pressure, as when several are laid in one capsule (*Lumbricus, Nephelis, Planaria*, etc), or when compressed by an unyielding shell. A very striking instance has recently been described by Repiachoff in the Supplement to Vol. xxx of the *Zeitschrift für wissenschaftliche Zoologie*. He describes the egg of *Tendra zostericola* (a European Bryozoön found on eel-grass) as having a fusiform shape, Fig. 2.

FIG. 2 —Egg of *Tendra zostericola*, after Repiachoff.

One other remarkable modification of the egg-cell occurs among spiders, and has not yet been observed in other animals. The eggs of some spiders (Fig. 3) contain, besides the nucleus, a second body, *k*, of about the same size as the nucleus, solid and resistant, and exhibiting indications of a series of concentric laminæ; this is probably only a specialized form of deutoplasm, similar to the four large oil globules described by Spengel in the eggs of *Bonellia viridis*.

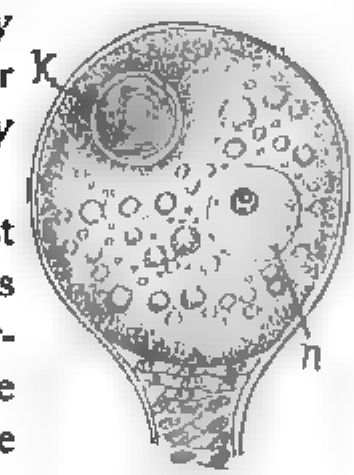

FIG. 3.—Egg-cell of *Tegenaria domestica*, after Balbiani; *n*, nucleus; *k*, laminate body.

When an egg-cell attains maturity, the first important and striking change that occurs is the translation of the nucleus close to the surface of the egg, where it disappears. The nucleus of the ripe ovum is usually called the germinative vesicle, and the phenomenon just alluded to is still generally termed the disappearance of the germinal vesicle. The fact has long been known, but was entirely inexplicable until the discoveries of the last few years afforded a partial explanation, by rendering it probable that the disappearance is not real but only apparent. The subject is still obscure, because the observers are not entirely agreed with one another as to the facts. The greatest difficulty arises from the fact that in most cases the egg-cell ejects two or three small bodies over the spot where the nucleus disappears. These bodies are called polar globules, and are known to occur in Cœlenterates, Echinoderms, Molluscs, various classes of worms, Tunicates, Ganoids and mammals, so that their existence in all cases might fairly be assumed, were it not that renewed special search for these bodies in Amphibia, by O. Hertwig, had failed to discover any trace of them. No

satisfactory observations of the polar globules of the eggs of any of the Rotifera or Arthropoda have yet been made; but, as the interest in this subject is very recent, the globules may yet be found in those classes.

When the polar globules *are* formed, the following events may be *assumed* probably to occur. Ed. van Beneden's account of the development of the polar globules in the rabbit may be especially mentioned as exceptional. The history as here given is based upon observations made upon a limited number of invertebrates. When the nucleus disappears it is replaced by a spindle-shaped body known as the *kern-spindel* or Anglice *nuclear spindle*, which is generally regarded as the metamorphosed nucleus. It consists (Fig. 4) of a small number of fine, parallel threads, which, converging towards either end, run out into two points. The fibres are all thickened in the middle at the same level; these thickenings produce the appearance of a distinct plate or disk in the middle (Strassburger's *Kernplatte*). It will be convenient to adhere to the term nuclear plate to designate these thickenings. The spindle lies perpendicular to the surface of the egg. The pointed end of each spindle occupies the center of a clear space, from around which radiate fine threads, thus producing a sun-like figure. The whole spindle, with the two suns, has been named the *amphiaster*.

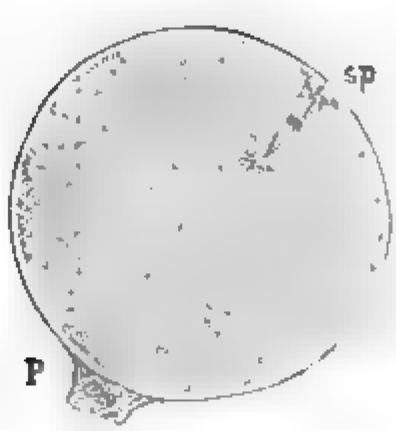

FIG. 4.—Ovarian egg of Hæmopis, after Hertwig; *sp*, nuclear spindle; *p*, peduncle attaching the egg to the ovary.

The character of the next series of changes is shown in Fig. 5. The spindle is partly excluded from the egg, one end projecting outwards and enclosed by a distinct mass of protoplasm, constricted around the base. The "kernplatte" has divided in two, one-half moved towards either end of the spindle. The spindle next divides and the inner moiety retreats into the egg, the outer into the protuberance, which thus becomes the first polar globule. The part of the spindle within the egg, transforms itself into a second spindle, which develops a second globule like the first. Frequently a third globule is also formed. The connection of the globules with the yolk lasts some time, and in the case of leeches is not dissolved until segmentation begins. These globules take no part in the further history of the egg: they disappear—how, is not

exactly known. The part of the spindle in the egg-cell, returns to the center of the egg and becomes a nucleus-like body, now termed the *female pronucleus.*

The egg-cell, therefore, divides into two parts, first, the egg proper with the female pronucleus, second, the polar globules. The egg-cell has become not as a whole, but partly, a real egg, the ultimate female sexual product. Since the use of the term egg cannot be restricted, and since precision of nomenclature is, in this case, particularly desirable, I have proposed the name *thelyblast* for the female element.

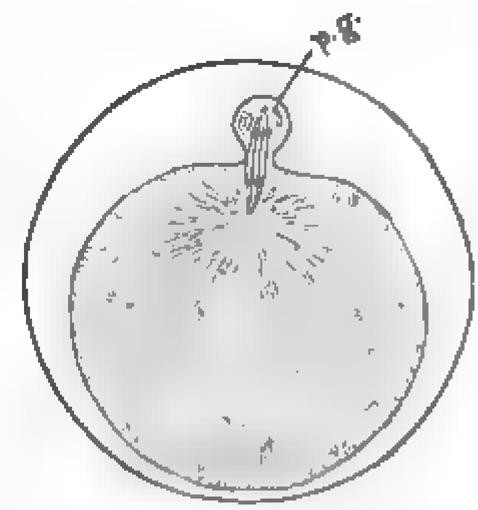

FIG. 5. — Egg of Nephelis three-quarters of an hour after laying. Formation of the first polar globule, after Hertwig.

We pass now to the history of the male elements, or spermatozoa, concerning which the observations of naturalists have been even less satisfactory. The adult spermatozoa have, with a few exceptions, an elongated, almost thread-like form, Fig. 6, and consist of a shorter and thicker portion, the head, *a*, a short middle piece, *b*, and a filiform tail, *d*, from which is suspended, in many vertebrates, a thin and very transparent undulating membrane, *c*. Innumerable modifications of this type occur by variations in the size and shape of the head and the length and thickness of the tail In a few exceptional cases, as among the nematode worms, the spermatozoa exhibit absolutely no trace of this form, but are apparently constructed upon an entirely distinct type. A few species of invertebrates have two forms of spermatozoa.

FIG. 6.—Fresh spermatozoön of *Salamandra maculosa*, after Gibbes. *a*, head; *b*, middle piece; *c*, membrane; *d*, tail.

In a not inconsiderable number of invertebrates, we find so-called spermatophores. These are only bundles of spermatozoa enclosed in a protective covering or shell (Fig. 7). In Cyclops this shell is secreted by the efferent duct, around the spermatozoa, just as the shell is secreted around the eggs by the oviduct. The spermatophores of some animals exhibit a very complicated structure, and have curious forms.

Like the eggs, or thelyblasts, the spermatozoa are developed out of cells, each cell forming not one sexual element, as in the case of the egg, but several. Hence several young elements appear within the interior of one cell at once; therefore this one cell is called the *spermatocyst*,[1] while the young elements which are to become spermatozoa, are called *spermatoblasts*, and lie within the mother-cell or the cyst. The spermatoblasts appear at first as cell-like, spherical bodies, which may multiply by division within the mother-cell. Their development progresses in the ordinary type of spermatozoön by a gradual elongation, the nucleus forming the greater part of the head, and the protoplasm, the tail, as has been described in the NATURALIST for July, 1877 (p. 397). These changes are so striking that they have absorbed the attention of investigators; hence the relation of the spermatoblasts to the parent-cell has been far less studied than its importance demands. At present, certainly, it is impossible to give any general account of the development of the spermatozoa. I shall, therefore, confine myself to a *résumé* of Semper's observations of the process in the sharks, his being the most complete special account of which I know. The principal stages are represented in Fig. 8, which are taken from preparations stained with hæmatoxiline.

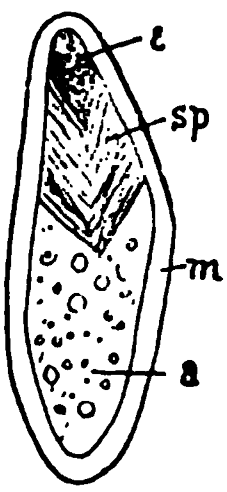

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FIG. 7.—Spermatophore of *Cyclops quadricornis*. *m*, covering membrane or shell; *sp*, spermatozoa.

In the earliest stage the spermatic follicle, or ampulla, *a*, is a cavity occupied by the remnants of a cell, which soon disappears. This cavity is lined by a layer of cells with large spherical, granular nuclei, and enclosed by an outer layer of cells with smaller dark, oval nuclei. The inner layer alone is directly concerned in the formation of the spermatozoa. In each one of the inner cells, which are the spermatocysts, the nucleus begins to multiply, as shown in *b*, *c*, *d*, *e*, dividing every time into two parts, one of which remains at the inner extremity of the cell and preserves the character of the parent nucleus, while the other recedes towards the outer end. The parent nucleus then again divides, until finally the spermatocyst contains one mother nucleus (*mutterkern*), and several daughter nuclei, which are easily distinguished by their

[1] The term spermatocyst has been used in various senses, but I believe the definition above given accords with the usage most widely accepted.

spherical shape and finely granular appearance. The daughter nuclei multiply by division. While these changes occur, the whole cell or spermatocyst becomes greatly elongated. At the completion of this stage, the parent nucleus at the inner end of the cell disappears, and a nucleus similar in appearance appears at the outer end, *f.* It is probable, but not demonstrated, that the two nuclei are identical, in other words, that the parent nucleus

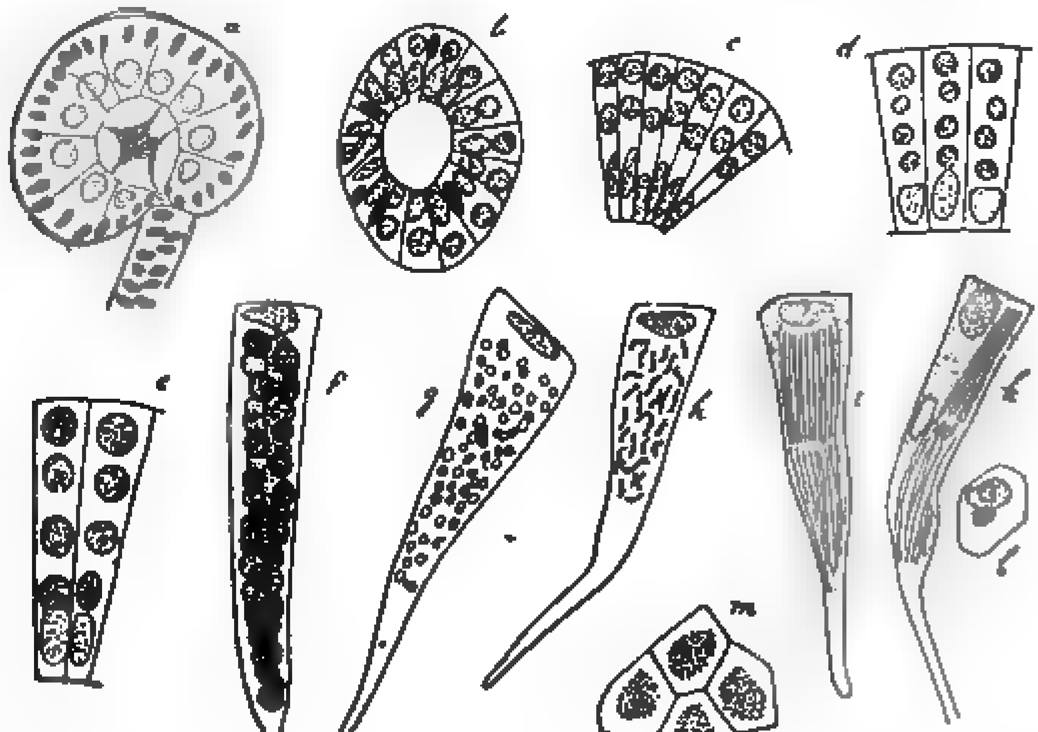

FIG. 8.—Development of the spermatozoa in sharks, after Semper.

migrates from one end to the other. The upper nucleus henceforth is passive, remaining behind to degenerate after the spermatozoa have been discharged from the cyst. Each one of the daughter nuclei, after subdividing still further so as to become very small, *g*, gathers a distinct mass of protoplasm around itself, and becomes a *spermatoblast.* The further development proceeds by alteration of the shape of these bodies: the nucleus elongates, becomes S-shaped, *h.* The elongation advances, the nuclei become straight and rod-like, and lie parallel to one another in the upper end of the cell, *i.* If we look at the cells from the outer surface of the ampulla, the center of the end of each cell is occupied by a cluster of dots corresponding to the bundle of rod-like nuclei seen endwise, *m.* Each long nucleus forms a spermatozoön head, which is connected with a thread-like tail. The development is completed by the discharge of the bundle of spermatozoa, leaving the large nucleus behind.

The essential feature of this whole history is, that a cell with a

single nucleus divides to form a compound body in which there is one large element with one kind of nucleus and numerous small elements, all with nuclei similar among themselves, but different from the single larger nucleus. The same thing occurs when the egg *sensu stricto*, or the thelyblast, is developed. In the case of the egg, it is the larger element which is preserved as the *female* part; in the case of the spermatocyst, it is the smaller elements which are preserved as the male parts. The two processes are complementary.

These facts have led to the following hypothesis of the relation of cells to the sexual elements. In an ordinary cell the two elements are intimately united in a latent condition, so that an ordinary cell is hermaphrodite or neuter, sexless, by which I mean it has no sexual differentiation. Diagrammatically this condition may be represented by Fig. 9, *A*. To form an egg the male portion is removed in several parts, which are the polar globules, while one large portion becomes the egg or thelyblast, Fig. 9, *B*. To form the spermatozoa, the two elements separate, the mother nucleus, or female part, remains behind, and if my hypothesis is correct, it, as well as the egg, must be called a thelyblast; the spermatozoa are discharged, and are capable of further vitality. They are the homologues of the polar globules. For both structures the common name *arsenoblast* has been suggested. If the above hypothesis is valid, then there is a fundamental distinction between cells on the one hand, and the *genoblasts* (the sexual products) on the other—every genoblast contains only one sexual element, every cell contains both. When sexual reproduction occurs, a thelyblast from one source unites with an arsenoblast from another source—the two by their fusion complete a perfect cell, which is called the impregnated ovum. In the next article this process will be described.

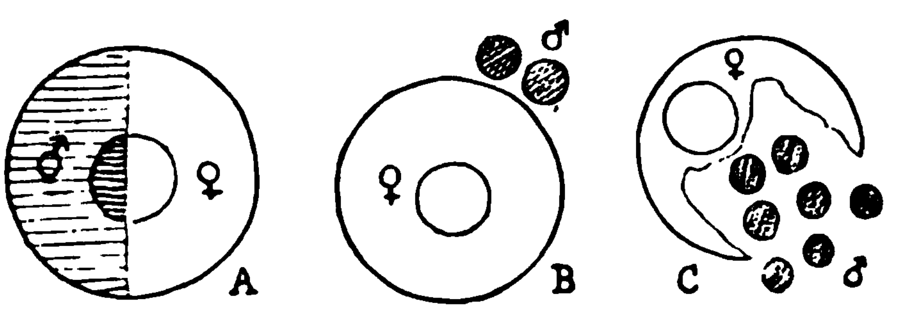

FIG. 9.—Diagrams to show the relation of the sexual products to cells. *A*, an ordinary cell; *B*, egg with polar globules; *C*, spermatocyst with spermatozoā.

In conclusion I wish to repeat that the conception of sex here advanced is only an hypothesis, which further research may cast aside, but which I hope may be confirmed, because it is already possible to bring forward many strong arguments in its favor.

For the convenience of those who may wish to pursue these subjects further, I quote below some of the principal articles, especially those which contain further bibliographical references :

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3ter Theil. Morph. Jahrb. IV, p. 177.
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THE CONVOLUTION OF THE TRACHEA IN THE SANDHILL AND WHOOPING CRANES.

BY THOMAS S. ROBERTS.

IT is well known to ornithologists, that in many birds there are various peculiar modifications of the trachea, or windpipe, which, it is supposed, serve the purpose of adding some particular quality to the voice. Passing by the numerous minor instances of this structure as seen frequently in ducks, in some geese and a few other birds, we find it most strikingly exhibited among the cranes and swans. In certain species of these two groups the trachea enters the enlarged and excavated keel of the sternum, and after a number of convolutions, varying in position and extent with the species, passes out at the place of entrance and thence into the lungs. In such cases, at least, it is plainly great strength and volume of tone which are imparted, as is clearly evidenced by the powerful utterances for which these birds are noted.

It is the present purpose to speak of this point of structure only as it exists in the two American species of cranes, *Grus americana* and *Grus canadensis*, with special attention called to its presence in the latter.

That the trachea is remarkably convoluted within the sternum in the whooping crane (*G. americana*) has been pointed out and fully described by Dr. Elliott Coues, in his "Birds of the North-west." But the mistake is there made of stating (on the evidence of others, I believe) that in the sandhill crane (*G. canadensis*) the trachea is simple; and this supposed entire difference between the two species is presented as strong anatomical evidence of their distinctness.

The fact is, however, that the trachea *is* convoluted within the keel in the sternum in *G. canadensis* as well as in *G. americana*. This I have determined by the examination of four sterna of *canadensis*, three of which were prepared by myself from birds positively identified as *canadensis* by the generally recognized external characters. Two sterna of *americana* have been examined: one the same that was described by Dr. Coues, and with which I have had the opportunity of comparing specimens through the courtesy of Dr. R. O. Sweeny, president of the St. Paul Academy of Natural Sciences; the other a specimen recently prepared by Mr. Wm. Howling, taxidermist, of Minneapolis, Minn., and in whose collection I saw the adult bird from which it was taken. One side of the keel was neatly cut away by Mr. Howling, at my suggestion, and the specimen freely offered for use in the present connection. It is identical in structure with the St. Paul specimen, and is the one from which the drawing has been made.

Although there is not such a radical difference as supposed by Dr. Coues, yet the two species are distinct in respect to their tracheal and sternal development. A glance at the drawings will show this at once. They are alike in so far as the trachea enters the sternal keel in each. But in *canadensis* the whole sternum is smaller and less stoutly developed; the coils of the windpipe are confined to the anterior half of the keel, and it is this portion alone that is enlarged; there are only about eight inches (average of four specimens) of windpipe in the keel, to twenty-seven inches (average of two specimens) in *americana;* the walls of the sternal cavity are much more imperfectly ossified than in *americana*, where they are everywhere on the outside dense, hard bone. On

the whole the entire conformation of the trachea and sternum in *canadensis* is much simpler than in *americana*.

Although only the anterior portion of the keel is enlarged for the reception of the trachea in *canadensis*, yet the remainder of

FIG. 1—*GRUS CANADENSIS*.

the keel is not solid bone; but, instead, is composed of two frail plates separated by a thin layer of bony meshwork. This light structure of the posterior part of the keel is more pronounced in some specimens than in others, reaching the greatest development yet seen, in a sternum which shows also the greatest convolution of the trachea.

The following short description of the course of the trachea within the keel in *canadensis* will be sufficient in connection with the drawing presented: Entering the keel at its lower anterior angle, the trachea follows the lower edge of the keel for about an

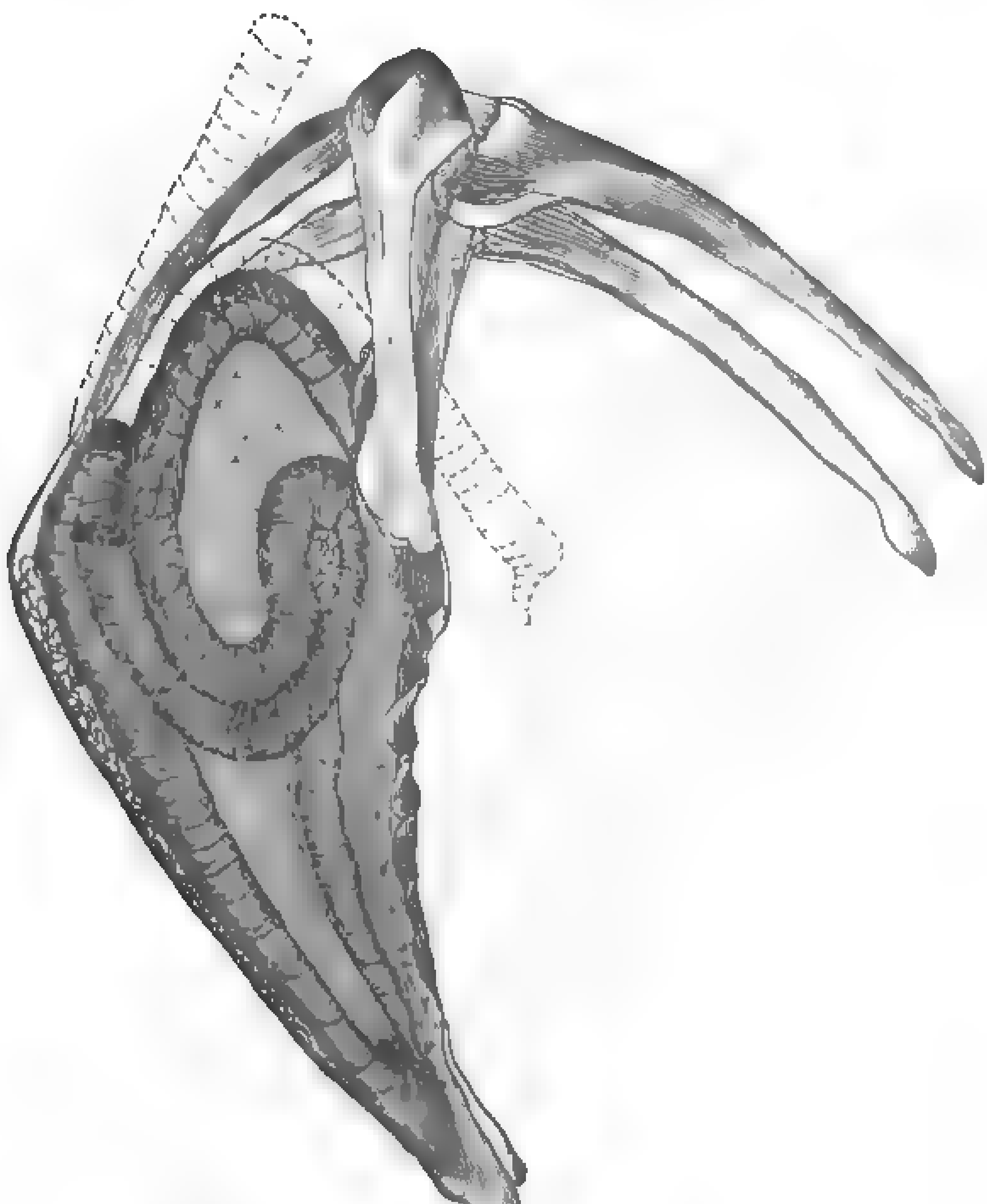

FIG. II—*GRUS AMERICANA.*

inch and then curves strongly upward and forward, until it has turned nearly one-half of a circle, when it passes by a scarcely perceptible curve to the upper anterior point of the sternum; lying for a part of the distance in a groove formed for its reception in the body of the bone and which is visible as a semi-cylindrical projection on the inner surface of the sternum in front.

From here the trachea reaches the point of entrance by a strong double curve, forming a figure which is a perfect letter S, the lower turn being within the first large coil, and the upper following the anterior outline of the keel. The cavity is three and one-quarter inches long, just one-half of the entire length of the keel. There are two unoccupied spaces between the coils—a small one filled with bony meshwork and a larger one entirely hollow. This description is from the specimen figured, which has been selected as representing very nearly the average of four. Two others show some variations worthy of mention. In a large sternum from a female bird, there is less convolution and fully two inches less of windpipe inside the keel. The upper loop does not fill the anterior part of the cavity, and on entering the keel the trachea does not go as far back or form the same kind of curve. But little more than one-half of the length of the keel is excavated. The third specimen shows a higher development than the one figured. The coils are large and occupy nearly the entire hollow, which is fully one-half the length of the keel. The posterior lower edge of the keel is thickened—much like the same part further forward—and cancellated inside; while the walls of the anterior cavity are more fully ossified than in either of the others.

In an embryo crane,[1] stated to be the sandhill, which was just about to break the shell when collected, the trachea does not enter the sternum at all and is perfectly simple. But the anterior part of the keel, which is, of course, entirely cartilaginous and very diminutive, is, comparatively speaking, much thickened, and a cross section shows it to consist of two thin walls separated by a marrow-like substance. In this feature of the sternum, we see the only indication in the embryo of the singular structure to be developed later in life. The degree of complexity of the trachea is thus shown to be dependent upon age, and the variations just alluded to are no doubt fully accounted for by this fact.

It is unnecessary to frame a new description of the convolutions of the trachea in *americana*, as that furnished by Dr. Coues is excellent. The following extracts from it are given for the convenience of the reader. "The sternal keel is broad and tumid, and is entirely excavated. The greater part of the excavation is occupied by the singular duplications of the trachea; * * but

[1] This specimen was obtained in the northwestern part of Minnesota, by Mr. Nathan Butler, and is now in the collection of the Minn. Acad. of Nat. Sci., Minneapolis, Minn.

there are two—an anterior and a posterior—large empty air cells in the bone, with smooth walls, and two other air cells—one superior and one along the edge of the keel—filled with light bony meshwork. * * * The trachea, entering the apex of the keel, traverses the whole contour of the keel in a long vertical coil, emerges at the front upper corner of the keel, enters again at the lower corner of the keel, and makes a smaller vertical coil in the center, emerging again where it went in. On looking at the object from the front, we see three parallel vertical coils side by side; the middle one is the trachea coming down from the neck above; on the left hand is the bulge of the first great coil; on the right is the windpipe passing to the lungs after it has made its second coil inside."[1] Following this is a statement to the effect that "there are about twenty-eight inches of windpipe coiled away in the breast-bone," and that altogether, from the upper larynx to the bronchi, the trachea is fifty-eight inches in length, and this in a bird that is little over four feet long from the tip of the bill to the end of the tail.

The average of three specimens shows the entire length of the trachea in *canadensis* to be about twenty-seven inches.

Audubon, who regarded *G. canadensis* as the young of *G. americana*, has, curiously enough, left us a description of the tracheal apparatus of the former but not of the latter. His description is taken from the sternum of a crane which he kept for a season in confinement, and which the reader would be led to infer turned white while in Audubon's possession, though this change of plumage is not directly stated to have occurred. I quote the brief description which, it will be readily seen, applies to *canadensis* and not to *americana*: "The trachea, which is thirteen inches long to its entrance between the crura of the furculum, passes into a cavity in the sternum where it curves so as to describe two-thirds of a circle, returns on the right side and enters the thorax by curving backwards. The cavity of the sternum is two inches long, with an equal depth, and a breadth of three-quarters of an inch. The ridge of the keel is, at its fore part, three-quarters in breadth, and contracts to one-half inch at its junction with the angle of the furcula, which is continuous with it. * * * * Boston specimen." It is strange that Audubon, who appears to have been a close

[1] Besides at page 530 of "Birds of the North-west," this description may also be found in full in *Forest and Stream* for Aug. 20, 1874.

observer of the general anatomical characteristics of his subjects, never examined the sternum of the adult *G. americana*, but only of what he considered the young. Yet we must conclude this to have been the case, for had it been otherwise, we certainly should not have been left with only the above description given without comment.

In conclusion, I cannot refrain from alluding to a subject which it were better, perhaps, to leave untouched at this time. In making careful, detailed comparisons of the several sterna in my possession, in order to determine exactly in what particulars the two species differ, I could but notice that only two important conditions need be fulfilled to change the sternum of *canadensis* into that of *americana*. If the remaining portion of the keel in *canadensis* were thickened and hollowed, and the trachea should gradually increase in length, the arrangement seen in *americana* would certainly result, for the disposition of the trachea in the latter species is exactly what would be produced by its forcing itself into the narrow limits of the keel. This may be simply an interesting relationship existing between the two structures, or it may have a deeper significance as the nature of the variations among the sterna of *canadensis* pointed out above, seems to imply. But considerations of this nature must be left for further investigation—until material of a determinative kind has been obtained.

EXPLANATION OF CUTS.

FIG. 1.—Sternum and lower part of trachea of the sandhill crane, *G. canadensis*. The left wall of the cavity has been removed, showing the trachea coiled away inside.

FIG. 2.—The same of the whooping crane, *G. americana*. The entire left side of the keel has been cut away to show the interior. The scapulars, clavicles and coracoids are in position in each.

These drawings were very kindly made for the illustration of this article by my friend, Mr. C. L. Herrick. They are about one-half natural size.

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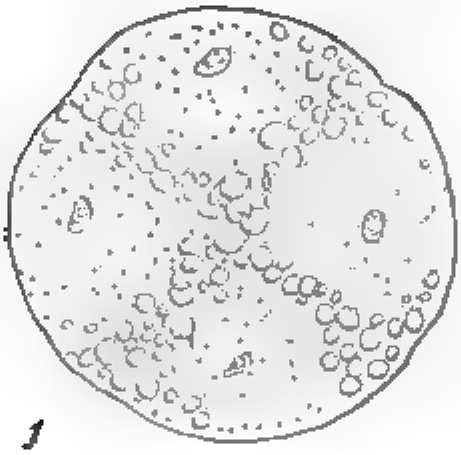
THE DEVELOPMENT OF MOINA.[1]

BY J. S. KINGSLEY.

DR. Carl Grobben having recently published one of the most complete accounts of the development of one of the Daphnidæ which has yet appeared, an abstract of his paper may prove of value to American naturalists.

[1] Die Entwickelungsgeschichte der *Moina rectirostris*. Arbiten aus dem Zoologischen Institute der Universität. Wien. Tom. II, 2 heft, 1879, pp. 66, pls. 7.



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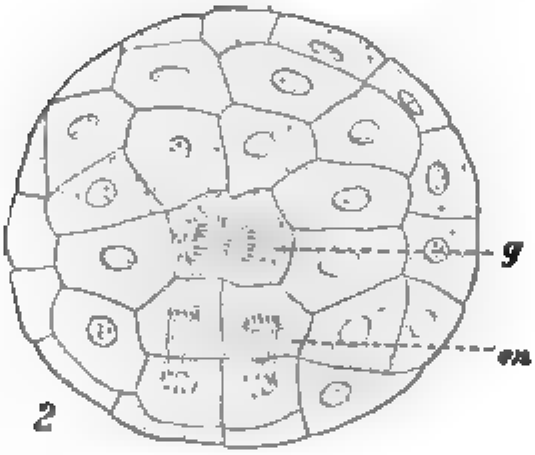
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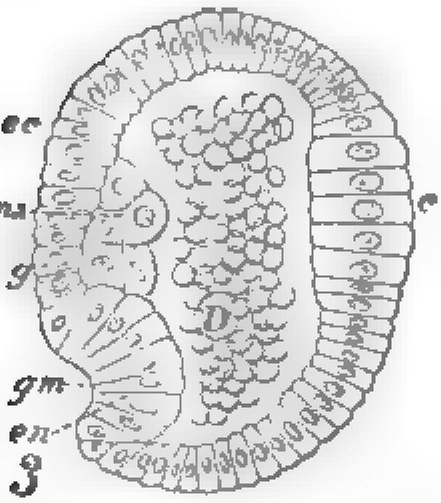
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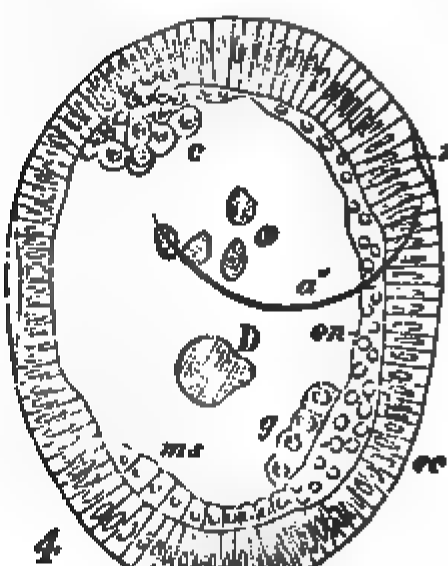
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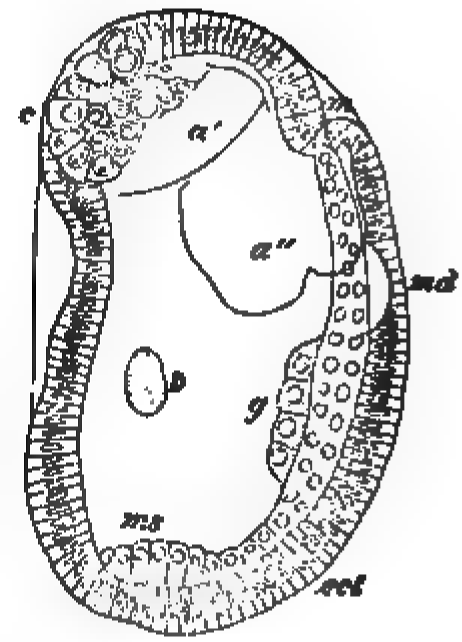
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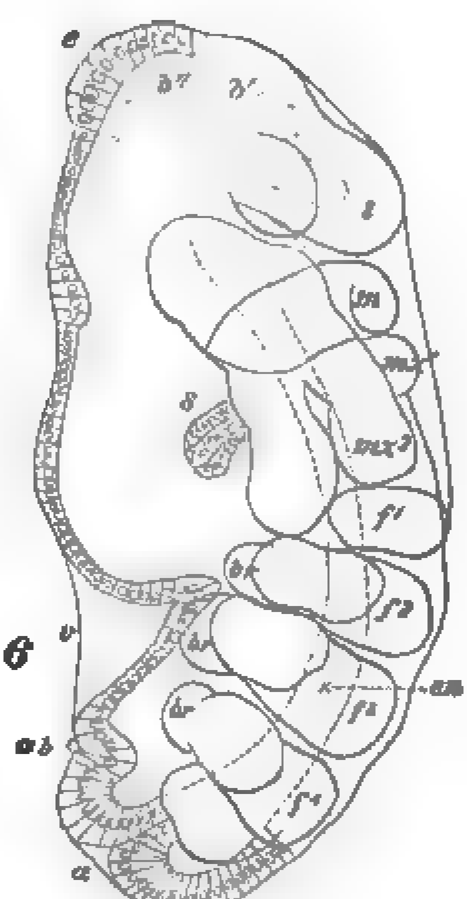
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The eggs of Moina are oval and measure about one-tenth of a millimetre in length. Segmentation occurs first on the minor and then on the major axis, thus producing four cleavage spheres. A polar view of these is shown in Fig. 1, the food granules (*deutoplasm*) being seen between the blastomeres. Another division produces eight segments, but after this, cleavage takes place at unequal rates in different parts of the egg. As we understand the matter, these cleavage planes do not all pass completely through the yolk. In the resulting mulberry stage the "genital cell" (which afterwards produces the genital system) is differentiated even before the first signs of the gastrula stage. (Fig. 2 *g*, genital cells or the cells which by invagination produce the endoderm. In these cells the so-called *Amphiaster* is shown.) Soon there begins an invagination of the endodermal cells, and other cells arise beneath the ectodermal cells near the genital cells. These form the mesoderm. Others, opposite the genital cells, are larger, and these form the cephalic germinal plate, "scheitel platte." (Fig. 3, an optical section; *ec*, ectoderm; *ms*, mesoderm; *g*, genital cells; *g m*, gastrula mouth; *en*, the cells which form the endoderm; *c*, cephalic germinal plate; *D*, deutoplasm.) Then the gastrula mouth closes up, the genital and endodermal cells become internal, the body is constricted and a fold is formed on either side, the first indication of appendages, which develops into the second antennæ. A depression occurs in the ectodermal cells, where finally the mouth appears. (Fig. 4, lettering as before; a'', second antennæ; *m*, depression for mouth.) In the next phase two more appendages have budded, the antennulæ and mandibles, while the antennal bud becomes two-lobed. This constitutes the nauplius stage. (Fig. 5, a', antennulæ; *md*, mandible.) Next, two of the thoracic feet are indicated, then two more, the brain begins to appear, the mouth depression is deeper, the anus is indicated and the genital cells divide and are placed on each side of the median line. Then the maxillæ and the fifth pair of feet appear; the eye begins to be developed from the ectodermal cells, the shell gland is present and the abdominal bristles are outlined. (Fig. 6, b' b'', brain; mx^1 mx^2, first and second maxillæ; f^1–f^5, thoracic feet; *br*, branchial sacs; *ab*, abdominal bristles; *a*, anus; *s*, shell gland; *v*, vitelline membrane; other letters as before.) The succeeding changes are those of increase in size of the appendages, in which joints appear, the formation of the shell, appearance of heart and the covering of the eye, and at last the animal acquires the perfect form (Fig. 7, from Baird).

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

——In our last number we called attention to the status of the modified organization of the Academy of Natural Sciences of Philadelphia, which was adopted four years ago. We also referred to a document relating to it, which was recently issued by a majority of a meeting of the council of that body. We criticised this document adversely, but did not enter into a detailed examination of it, thinking that the general confusion of ideas and unworthiness of sentiment to be found in it, were too self-evident to require refutation. Since, however, many of the members of the academy have voted to support the policy which is embodied in it, some of whom have not understood its drift, while others have not even read it, we give space to a criticism of some of its salient points.

From the positions assumed by the author of this document, we select the following:

(1.) "Under the letter and spirit of the by-laws, the professors constitute, in fact, a class of beneficiaries of the academy. * * It is not apparent that it is essential to the prosperity of the academy to admit any class of its beneficiaries or subordinates to participate in the administration of its affairs. Nor is it manifest that their studies or the performance of their prescribed duties would be facilitated by their being made members of the council for life" (p. 9). Imagine language like this addressed to the academicians of Paris or St. Petersburg! And the presence in the council of two paid employés of the academy at the present time, has never disturbed any one's composure, probably because they are not likely to be candidates for professorial honors.

(2.) "Those students who are not obliged to follow a vocation for a livelihood are not in need of the benefits of a professorship, or of the Jessup Fund, to enable them to pursue their studies in the academy" (p. 9). So then, Hébert and Gaudry, and others, are not eligible to chairs in the Jardin des Plantes and the Sorbonne, because they are rich; and so with many others in all parts of Europe! But there are reasons other than the possession of pecuniary means, why a man should not be a professor in the academy; for,

(3.) "The professors are to have custody of all the collections in the museum, worth together, possibly, a quarter of a million

of dollars. They give no valuable security or pledge to be forfeited should they fail to preserve the integrity of the collections. * * No better opportunity can be offered to tempt men to enrich their private cabinets at the expense of the academy than this proposition presents. It is not prudent to expose the property of the academy to such chances without any check or protection under its own laws, and confide it unreservedly to the purity and incorruptibility of the professors and the laws which inflict punishment for larceny and burglary." The author of this language does not seem to be aware that it must excite astonishment in the minds of scientists everywhere, and that it is a boomerang which recoils upon the policy he supports. If there is any class of persons to whom property of an academy of sciences should *not* be entrusted, it is the amateurs and collectors who do not make original research their profession. Now too lax in administration of a collection, some accident occurs; then too strict in their surveillance, collections become practically inaccessible. Not knowing the value of material from the standpoint of research, they accumulate show collections, and neglect the fields where science reaps her true harvests. The true scientist does not care to possess collections, excepting so far as they are necessary for the prosecution of research, and depredations on museums do not come from this class. Once in charge of a museum of importance, they naturally take pride in it, and spare no pains to preserve in it all records of scientific work. This can never be felt by the mere employé, nor by the average corporation trustee. Neither class can criticise the work of the specialist as the specialists can each other. Not to enumerate self-evident truths, the sum of the matter is, that this document desires the exclusion from the administration of the collections, the only persons who are competent for the work. It demands security from these, while none is required at present from men who are entirely ineligible.

We do not believe that a majority of the members of the academy are prepared to sustain the above positions, but suspect that their votes have been influenced by consideration of the three following very misleading statements, which form the recapitulation at the close of the paper under consideration.

(1.) We quote: "It is notorious that the Academy, since its beginning in 1812, has been managed chiefly by, and always in the interest of its experts, those members most distinguished for their learning, and students" (p. 10). This we deny; and in evidence state that instead of its being managed by its experts, there are, at present, in a council normally of twenty-three members, but four who make the pursuit of science their business, but two of whom are officers of the academy, and only one of whom is a curator. Moreover, the by-laws expressly provide that the prospective professors *shall not be members* of the coun-

cil. Whether it is managed in the interest of the specialists may be inferred from the fact that most of these gentlemen do their work at private houses and do not place their collections in the building of the academy. It is undoubtedly to the interest of the original investigator, at the present time not to work there, and many reasons for this may be elicited, on enquiry, by any one interested in pursuing this part of the subject.

(2.) It is objected, in various paragraphs that "the effect of the proposed alteration will be to make the council ultimately consist of twelve professors elected by the council for life and the eleven officers of the academy elected annually for one year. The officers of the academy will always be a minority in the council, and when one person fills two offices this minority will be more decided." In our opinion this provision is an important element in the proper administration of the affairs of an academy of sciences. The development of science being the primary object of the institution, those persons who devote their time to it should constitute a majority of its management, while others may be called in as important aids and counsellors. In institutions having other objects it is customary to call in scientific experts as aids, but not to make them a majority of the management. It is also evident that the specialists are the best, if not the only critics of each other's conduct, while the supposition that they will combine to plunder the academy, is preposterous. But here let us observe, that as the by-laws provide that the council shall elect the professors, the matter is in their own hands as to what class shall be in the majority. Hence the statement that the new by-law discussed, at once creates a majority of professors in the council, is erroneous. And it was on this false issue that the late election was probably decided. It will be very easy to rectify any defects of this part of the plan, if necessary.

(3.) "The appointment of professors cannot be reasonably expected until endowments for their compensation have been obtained." This proposition has been put forth *ad nauseam* by the opponents of the plan under discussion. Having excluded professors from council, they ask for applications, and because there are none, expect us to believe that the plan "has failed" for want of funds. They ignore the fact that the curators who now perform the more laborious part of the work of the proposed professors are not salaried officers, though they employ one of their own number to fulfill certain duties. They forget that one professor has been appointed and is performing his duties. They do not realize, perhaps, that the learned conservator of the conchological section is, in all important respects, professor at the present time. And such has been the advantage of this arrangement, that that department has expanded into the most extensive one in the institution. Why cannot other departments be similarly administered? The scientists of the city who are working in their

own studios are certainly not getting salaries for it! It is to the advantage of the academy to utilize, if possible, all these now scattered ways and means. And is it not a reflection on human nature that suggestions to this end should be looked upon as "Macchiavellian schemes for selfish ends," or attempts to obtain control of the academy's collections? We want no better evidence than such language, to show that something more important than money is wanting here. The need of something else was very evident during our Centennial, when enormous collections, which might have been had for the asking, were allowed to be taken to Washington under our very eyes.

We close with an allusion to the opinion expressed in this part of the paper, that "the professors would be the only experts who would have free access to the collections." There is no provision to this effect expressed or implied in the by-laws or the proposed alteration of them. The by-laws provide for the reverse. The privileges now enjoyed by members of the academy would not be restricted in the least, but would rather be increased through the additions to the collections which would follow. The new by-law simply protects the new material which may hereafter be obtained through the exertions of a professor for purposes of research, from distribution through the museum, before it is used, and specifies who shall use it first. This is simple justice, and it will ever remain the condition on which the academy's collections can be increased in any important degree. Expectations of obtaining collections in any other way are illusive. By new material is not meant material new to the museum, but that which is new to science. At present, this entire subject, which is the working basis of the institution, is thoroughly misunderstood. It is not well to fear the granting of these privileges, for it is a question of their being enjoyed by a few persons or by none at all. No two persons can use the same material at the same time, nor can its first use be enjoyed by more than one person.

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RECENT LITERATURE.

NOTES ON NEW ENGLAND ISOPODA.[1]—In this paper we have a list, with notes on the distribution, of forty-three species of Isopoda found on the coast of New England (including one which has not yet been observed south of Labrador). *Janira spinosa* and *Leptochela rapax* are the only new species described. Of these forty-three species, ten have been found only south of Cape Cod; fifteen are common to both sides, and eighteen appear only north of the cape, and eleven occur on the European shores. Of these eleven, *Tanais vittatus* has been found south of the

[1] *Notes on New England Isopoda.* By OSCAR HARGER. Proceedings of the United States National Museum, 1879, pp. 157–165.

cape, but not north, while *Jæra albifrons* (*copiosa* Stm.), *Idotea irrorata*, *Limnoria lignorum* and *Leptochela algicola* are found on both sides of that promontory. In the paper we notice that no species of Bopyridæ (with the exception of *Cepon distortus*) is reported south of Massachusetts. Dr. Leidy informs us that during the last summer he found *Crangon vulgaris* at Atlantic City, N. J., badly infested with another species.—*J. S. K.*

CARCINOLOGICAL PAPERS OF PAUL MAYER.[1]—We have here two papers, one on the color changes of the Isopoda, the other descriptive of a new parasitic crustacean, *Ive balanoglossi*, found, as the name indicates, in the body cavity of *Balanoglossu*. The sexes closely resemble each other, except that the males are much the smaller. The body is not segmented, but the five pairs of appendages which are present show their articulate character more plainly than in many Lerneans. The stomach is a blind sac, and the circulatory apparatus is wanting. The male adheres to the female near the genital opening. Dr. Mayer succeeded in rearing the Nauplius from eggs.—*J. S. K.*

HERRICK'S ENTOMOSTRACA.[2]—It is occasionally our lot to run across the productions of some naturalist, who, laboring under the impression that the scientific world has been at a standstill for a quarter of a century, deems it his duty to start it, and the result is almost invariably the same, it retards the motion which, though inappreciable to his senses, nevertheless existed. The time necessary to unravel the confusion produced in synonymy by such persons is enormous, and the amount of work required can only be appreciated by the systematist.

Such a work is now before us and seems to demand some slight attention. The author seems to have had very slight access to the literature of the subject, and to be entirely ignorant of any work done since the days of Baird's British Entomostraca (1850), and Dana's Crustacea of the U. S. Exploring Expedition (1852), the works of Claus, P. E. Müller, G. O. Sars, Lilljeborg, Brady, Birge, etc., being unknown to him. The synonymy quoted, however, would at first sight indicate an extensive acquaintance with the bibliography, but a slight examination shows that all references are taken second-hand and no credit is given; for instance, fifty-five references are quoted from *Daphnia pulex* verbatim (but owing to careless proof reading not literatim) from Baird's British Entomostraca, and we would venture to say not one of them has been verified by our author, and what is more, his Pierian font, Baird's work, is not quoted at all in connection with that species. We had supposed that the classification of the lower crustacea

[1] Mittheilungen aus der Zoologischen, Station zu Neapel. 1 bd. 4 heft, page 515–522 one plate, 1879.

[2] Microscopic Entomostraca, by C. L. Herrick, in the Seventh Annual Report of the Geological and Natural History Survey of Minnesota, 1879, pp. 81-123. Pl. 21.

was in passable condition, but we are informed [p. 84] that "it is not possible at this stage of the study to attempt a systematic arrangement." On page 85 it is stated that the Rhizocephala and and Cirripedia " are enclosed in a hard shell-like test," which is true of no adult; Rhizocephala and some barnacles are exceptions. On the same page we are told that the sucker-like organ on the head of *Sida* corresponds to the pedicle [peduncle] of the barnacles, a statement showing very elastic ideas of homology. Our author, also contrary to the ideas of the best morphologists, recognizes an ocular segment, and excludes the telson from a position among the somites of the body. The NATURALIST is not the place, nor have we time to rectify the synonymy of the forms described, and to assign them to their proper position, but several forms, if the drawings are accurate, are placed at least in wrong genera. The typographical errors are numerous; Desmarest's name appears with three different orthographies, the abbreviation " Enc. méth" under three distinct forms. Lovén as " Loren," somite as "somnite" on p. 90, occurs the word " setigiferous," but the worst of all is "qualities" for gnathites (p. 86).

The illustrative figures are clearly printed, but of their accuracy we are not certain, and many points which are important from a systematic standpoint are slighted or ignored, thus rendering it difficult for the future reviser of the American species to classify the forms here described, and a quotation from p. 86, seems to exactly describe the condition of affairs brought about by this work. The curious misapprehensions and inaccuracies into which authors have fallen still further complicates the matter.—*J. S. Kingsley.*

THE MISSES JONES AND SHULZE'S NESTS AND EGGS OF THE BIRDS OF OHIO[1]—The just appreciation and cordial encouragement accorded by scientific critics to Part I, of this beautiful work must have prepared a welcome on the part of the public for the further installment issued in October last. Not only does its unique *ensemble* render it attractive, but it presents a combination of the useful and the agreeable of science and of art, to a very rare degree. In these days, when the great majority of periodical publications afford specimens of the progress in art-culture in this country, and the public grows more capable of criticizing the results of original efforts with the pencil and brush, such work as the talented and enterprising authors of these "Illustrations" have wrought, will be justly ranked high in general estimation. The originality of method of this work, which copies some of the prettiest and most varied objects in nature, the pleasing combinations in the drawings, the faithfully imitative style of coloring, and the tasteful finish of the text,

[1] Illustrations of the Nests and Eggs of the Birds of Ohio. With text. By Genevieve E. Jones and Eliza J. Shulze. Folio. Published by the Authors. Circleville, Ohio. (Part II.)

render these folios almost matchless as contributions to natural science, and to picturesque art for the library or for the parlor table. The sad death of one of the authors, in early life, and in sight of the goal of success, has added an appeal to our sympathy to the just claims of the work upon public appreciation. Miss Jones died last August, of a fever doubtless aggravated by her earnest efforts and mental anxiety concerning her work, though that portion of her labor already accomplished will be incorporated in the numbers of the publication yet to appear, Miss Shulze is engaged with Miss Jones's parents in the completion of the plan in which the two ladies originally joined; and Miss Jones's name will continue to be appropriately connected with that of the surviving *collaborateuse.* The present part gives three illustrations, being those of the Indigo bird, *Cyanospiza cyanea,* the marsh blackbird, *Agelæus phœniceus,* and the kingbird, *Tyrannus carolinensis,* with text of the crow blackbird, *Quiscalus æneus.* The work will continue in parts until the 100 plates are completed.—*Sarah O. Aiken, Washington, D. C.*

NICHOLSON'S MANUAL OF PALÆONTOLOGY.[1]—The present book consists of two volumes of nicely printed text, illustrated by many good engravings. The attractive appearance of the "Manual," and the fact that it contains a good deal of information, compiled from many sources, produces a favorable impression, and leads one to expect an able treatment of the subject matter. So far as regards the department of *Vertebrata* we are disappointed. The work, doubtless, has a value in bringing to the notice of students a considerable number of extinct forms, by furnishing good wood engravings. The cuts of recent Vertebrata are generally bad. But the definitions, especially those of the higher groups, are exceedingly defective, and the classifications adopted are generally antiquated or incorrect. In old world palæontology we find, for instance, the classification of *Stegocephali* ("*Labyrinthodontia*") of Mr. Miall incorporated bodily; a system, if such it can be called, where all sorts of characters have been put to impossible uses, and the laws of nomenclature extensively disregarded. Especial prominence has been given to American palæontology, but it is evident that, to use a political phrase, the delegation from the United States has been "fixed." The author has profited singularly little by the publications of the General and State Governments of America, but has apparently taken as his guide, Prof. O. C. Marsh's address before the American Association for 1877. This paper is well known here as little more than a record of what is taught by its author to the exclusion of other authorities, and on this account

[1] *A Manual of Palæontology for the use of Students, etc.* By HENRY ALLEYNE NICHOLSON, Prof. of Nat. History in the University of St. Andrews. 2 vol. Wm. Blackwood & Sons, Edinburgh, 1879.

does not represent the subject to which it refers. If the author of the manual under review will examine into the claims of the nomenclature he has so extensively quoted from this source, he will find that a great part of it has either no foundation in analytical work, or has been proposed without regard to priority. Such are *Dinoceras*, *Brontotheridæ*, *Pliohippus*, etc., etc. The erroneous figure of the skull of *Coryphodon* is copied, when a correct one could easily have been found. Further attention to this department will enable the author to do it justice in a future edition.

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GENERAL NOTES.

BOTANY.

FERTILIZATION OF FLOWERS BY HUMMING BIRDS.[1]—For several years some persons of this place have been watching the birds about flowers. They visit flowers for at least two objects, for insects and for nectar, and perhaps for pollen in some cases. Pollen grains have been found on the bill and feathers of the head of humming birds. These birds have been seen to frequent flowers of pelargoniums, fuchsias, trumpet-creepers, phloxes, verbenas, catmint, milkweed, tropæolums, honeysuckles, lilacs, morning-glories, cherry, wild balsams. I have no doubt they visit a great variety of other flowers which secrete honey in abundance. Mr. Osband visited trumpet-creepers, in flower, in bright days, and always saw birds. On one plant he saw eight birds at one time.

The pollen of fuchsias is sticky or in strings. Humming birds are the main visitors to the flowers. The calyx tube seems too long and narrow for most insects. Mr. Hollingsworth is very sure these birds visit the plant for nectar. Sometimes they pierce through the base of the calyx tube and take out the nectar. The student last named covered some flowers and found the stigmas were dusted with pollen without the aid of bees or birds. The ovaries also swelled as though forming seeds.

Mr. Wm. Snyder observed the fertilization of *Impatiens fulva*. The anthers form a covering over the pistil. He tied bags over young flower buds, also over flowers which had opened but before the stamens had disappeared. In both cases no good seeds were produced. Some he tied up and artificially crossed. The latter, without exception, matured fruit. In other cases he cut off all the petals of the flowers. He took down the signs. None of these set fruit. In other cases the nectar gland only was removed, with no fruit setting.

Sometimes he saw a large number of black bees at work, seemingly trying to get what exercise and nectar they could. They ran in and out many times, and hardly ever touched an anther or pistil. He could not see that the insects were of any use in fertilizing the flowers. Small wild bees behaved no better as far as carrying pollen was concerned. A common honey bee availed nothing in this direction. One humble bee hit pollen in

[1] Notes taken from papers of his young students by Prof. W. J. Beal.

his plunges to get at the nectar, but left the plant after trying a single flower. In frequent visits he often saw humming birds about the flowers going to all that were open at the time. Every time the birds thrust their beaks into the flowers, if the stamens had not yet been removed, the head, a little above the beak, would hit these and become dusted with pollen. Where the anthers had been removed the birds head left pollen on the stigmas. He saw, in one cluster, all the flowers visited twice in fifteen minutes. He is confident that *Impatiens fulva* is cross-fertilized mainly, if not wholly by humming birds.

CONNECTION OF THE RAINFALL WITH FORESTS.—According to a paper in *Polybiblion*, the following are the laws of meteorology as affected by forests:—1. It rains more abundantly, under identical circumstances, over forests than over non-wooded ground, and most abundantly over forests with trees in a green condition. 2. The degree of saturation of the air by moisture is greater above forests than over non-wooded ground, and much greater over masses of *Pinus sylvestris* than over masses of leaved species. 3. The leafage and branches of leafed trees intercept one-third, and those of resinous trees the half of the rainwater, which afterwards returns to the atmosphere by evaporation. On the other hand, these same leaves and branches restrain the evaporation of the water which reaches the ground, and that evaporation is nearly four times less under a mass of leafed forest than in the open, and two and one-third times only under a mass of pines. 4. The laws of the change of temperature out of and under wood are similar so those which result from the observations of M. Mathieu. The general conclusion seems to be that forests regulate the function of water, and exercise on the temperature, as on the atmosphere, an effect of "ponderation" and equilibrium.—*English Mechanic.*

THE NEW MEXICAN LOCUST TREE, ETC.—In the article on Colorado plants in the November number, on page 681, in the note on *Salix flavescens*, the word "hybrid" should read "form." It is apparent that no "hybrid" can occur unless both parents are found in the same vicinity, which in this instance is not the case. *Saxifraga chrysantha* from Pike's Peak is apparently the same as *S. serpyllifolia* of Porter and Coulter's Catalogue. *Artemesia arctica*, *Cnicus edulis* and *Troximon glaucum* are referred to, the last two under other names. *Robinia Neomexicana* is described therein also. E. L. Green, who first collected this species in Colorado, furnishes me with some interesting facts regarding it, which I take the liberty to quote from his letter. "The clump of trees to which you refer was found by me in 1873. It remains to-day the only known habitat of the species north of New Mexico, and strange to say, those trees are twice as large as any I ever saw in New Mexico; right on the banks of the river, and all around that clump of locusts grows *Bigelovia greenei*, which

no other botanist but myself has ever collected, although Drs. Hooker and Gray were over the same ground in 1877, and the plant is common along several of Dr. Parry's routes in New Mexico. The shrub at a distance, yes, even at the distance of a man's eyes from the ground at his feet, looks so much like *Gutierrezia euthamiæ* (which grows with it) that it must have been confounded with that plant by the numerous botanists who have crossed the vast tract of country which it inhabits."—*Isaac C. Martindale.*

INSECTS CAUGHT BY THE PHYSIANTHUS.—I am reminded, on reading the account of the manner in which insects are caught in the anther-wings of *Physianthus albens*, published in the last number of the AMERICAN NATURALIST, that I exhibited to the Boston Society of Natural History, Sept. 1, 1852, a specimen of that plant, and read a description of the manner in which insects became imprisoned in its anthers. The following passage is published in the report of my remarks: "The insects catch themselves, and so often does this occur that a gentleman in New York has obtained butterflies, bees and a great variety of other insects, enough to fill a large case, from the flowers of a plant growing in his garden."—*Chas. J. Sprague.*

We would also add that Prof. C. V. Riley, as he tells us, several years ago recorded in the Proceedings of the American Association for the Advancement of Science, the fact that he had found moths entrapped by the same plant.—*Editors.*

BOTANICAL NOTES.—The *Bulletin* of the Torrey Botanical Club, for November (received December 28th) contains farther notes on ballast plants near New York City, by Mr. A. Brown; and Prof. Eaton contributes the 7th of his articles on new and little-known ferns of the United States. The *Journal of Botany*, hitherto conducted by Mr. Henry Trimen will be edited by Mr. Brittain, during the absence of the former in Ceylon, as Director of the Botanical Gardens. This journal records the death of the following botanists: J. F. Von Brandt, a joint author with the late Dr. Ratzeburg, of the Medical Botany and Zoölogy; Carlo Bagnis, aged 24, and Professor of Botany in the new University of Rome; C. J. M. Von Klinggraff, author of a Flora of Prussia, and a memoir on the plant geography of Northern and Arctic Europe. ——*Grevillea* for December, notices Californian Sphæriæ, and prints an article on the propagation of *Sphæria fimbriata*, by C. B. Plowright.——The new part of Bentham and Hooker's Genera of Plants, will be issued in January, and will complete the Dicotyledonæ. The last part only remains to be published.—— Sir. J. D. Hooker has called attention to the discovery of a variety of the cedar of Lebanon on the mountains of Cyprus.

ZOÖLOGY.[1]

LEATHER TURTLE.—*Apropos* of the article on the "Leather Tortoise," in the October NATURALIST, perhaps the following may be of interest to the author.

A few years ago, in looking over the papers of Col. Richard Varick, the first mayor of the City of New York, in search of autographs and documents relating to the Revolutionary War, I came across a small circular, about six to seven inches in size, printed on the rough, unsized paper used by our forefathers, and of which the following is a copy of the subject matter:

"The dimensions of the *Testudo coriacea*, or leather tortoise, caught by Samuel Coon, one of the branch pilots of New York, on board the *Young Pilot*, by way of Sandy Hook, on the 27th Sept., 1811, and purchased by John Soudder, proprietor of the American Museum, Nō. 24 Chatham St., are as follows, taken under the eye of Dr. Mitchell, professor of natural history:

	Feet.	Inches.
Length from extremity of the snout to the end of the tail......	7	6
Length of the buckler between the neck and tail..............	5	8
Girth of the body...............................	8	0
Circumference of the buckler..........................	13	2
" " neck...........................	3	5
" of fore fin above the joint.....................	2	5
" " " at the joint.....................	2	8
Length of the fore fin..............................	3	9½
" " head and neck from the buckler..............	1	7½
Distance between the extreme tips of the two fore fins.........	8	5
Breadth of the buckler..............................	3	10½
Length of the hinder fin..............................	2	1
Circumference of the hinder fin.........................	2	4½
Distance between the extreme tips of the two hinder fins.......	5	5
Length of the tail................................	1	0
Circumference of the tail in the middle....................	1	5
Projection of the tail beyond the buckler..................	0	4
Width of the mouth across from corner to corner.............	0	10
Distance from the upper to the lower extremity of the jaws when the mouth was wide open..........................	0	9½
Circumference of the eye-ball after extraction from the socket..	0	5½

"His weight, when taken, was supposed to be rising 900 lbs., but from the loss of blood previous to his death, he weighed only 800 lbs."

This little circular, if thus it may be styled, is a very neat and modest one, and was, perhaps, printed by the proprietor of the museum to call attention to the specimen. You will perceive that this capture antedates the one you mention as having been made in Massachusetts bay by thirteen years.—*W. R. Gerard.*

THE CHIPPING VERSUS THE EUROPEAN SPARROW.—During the last two seasons the much dreaded European cabbage worm (*Pieris rapæ*) has been infesting the cabbage in this vicinity.

[1]The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

Several years earlier came that other pest, the European sparrow (*Passer domesticus*), and has pretty thoroughly driven away most of the other species of birds that are usually common about dwellings. On my own premises, instead of the cheerful music of the wren, robin and cat-bird, which formerly helped to make the surroundings attractive, I am compelled to be annoyed by miserable squeaks. This season a cabbage patch in my garden became thoroughly infested by the worms; I looked anxiously to see how thoroughly the European sparrow would do the work for which it has been transported over thousands of miles of land and water. But it was very seldom that any of the numerous individuals that have harbored about me for the past several years ever went near the patch; occasionally one of the young would fly down and take a worm, but I never saw a full-grown individual take one.

By accident I was observing the patch early in the morning, from day-break to a short time after sun-rise, when I chanced to find a number of chipping sparrows (*Spizella socialis* Bon.), taking worms as busily as possible. By continuing my observations I found this was the case every *morning* as long as the worms lasted; but during the rest of the day "chippy" was seldom seen in the patch. Whether this early feeding is the natural habit of this species, or whether it was not allowed to go about the premises during the rest of the day, I cannot say. But it did such efficient work that I feel it my duty to make it as widely known as possible.—*S. Schneck, M.D., Mt. Carmel, Ill.*

DEPREDATIONS OF THE EUROPEAN SPARROW.—The following case, represented to me by Dr. A. K. Fisher, of Sing Sing, N. Y., substantiates one of the many charges brought against *Passer domesticus.*

"About a year ago I was interested in watching a sparrow pulling up peas in a neighbor's garden. The peas were up about an inch; the bird went along the row, taking the vines in his bill, placing his foot near the roots and pulling up the shoots and eating the peas. I saw him thus destroy several, when I stopped him by throwing a stone which unluckily missed him.

"The old saying that 'Birds of a feather flock together' is verified in the case of the sparrow's associates. The only bird which I have ever found which seemed to enjoy the company of the English sparrow, is that miserable form of bird life, the *Molothrus ater.* It would be difficut to find two more disreputable birds than this precious pair. Here they mix together a good deal, especially when the sparrows are a little way out of the village."—*Elliott Coues, Washington, D. C.*

ON THE TORPIDITY OF ANIMALS.—Some time in early December, 1878, when the snow first began to fly, a silver-haired bat, without a place to lie dormant in for the winter, flew into my hallway, about

nine in the evening, at Evanston, Ill. I was surprised at discovering a bat at that time of year, and secured it in a box. It was a bitter cold night and the bat hung himself up by its claws on the edge of the box among the cotton and went into a torpid state. Several days afterward I placed him over the fire and thawed him out. He became quite lively in the warmth, took a drop of water and flew around the room. The following night was the coldest of the season, and it again went into a torpid state and remained some two weeks in that condition before it was disturbed. My efforts to bring it to life on this occasion were not so successful as formerly. After much warming it came to sufficiently so that two spots of breath would appear on the mirror when held to it. In order to get a greater amount of heat to operate on it, I placed the box containing it on the fancy top of the stove, turned my back to it and became engaged in writing. I had written some time when my attention was aroused to a bad scent in the room. I turned around but to behold box and bat wrapped in flames. This ended my experiments in that direction, I had arrived at the following conclusions, however: That animals in a torpid state may be aroused by an application of heat; or, in other words, torpidity is but a state of lowered temperature of the body. I am strengthened in this conclusion by some observations of no little importance to the topic under consideration.

The torpidity of swallows has long been regarded as a tradition, but traditions are generally founded on fact, however perverted the facts may be. A young man, whose word I regard in all matters as perfectly trustworthy, told me that one April day while out gunning, he treed a coon. He borrowed an axe and as the tree was falling a half-bushel of swallows rolled out from the hollow. In the warm sun of the early spring day many of these took life, and consequently wings, and flew away. And why not!

Last winter the papers were prolific with stories about the resuscitation of sheep, cows, and even men, from a frozen state. Indeed, it is no secret of late years that the heat generated by a dog will easily bring to its natural state a frozen limb of a man. I noticed this fact in the South, the overflow of the Mississippi river leaves thousands of little ponds full of fishes, which in winter freeze up solidly. The fishes are confined in the ice. When these ponds thaw out, in spring, the fishes are liberated and go sporting about immediately. Fishes, of course, are cold-blooded and may not be affected by the ice. The fact remains, however, that during the winter a party of us were mapping the Mississippi, about Cairo, in Illinois, Kentucky, and Missouri, and that each day these fishes could be seen, frozen stiff, in the ice, many of which we cut out and examied, and from all appearances, were as dead as the logs that strewed the ground. But with the approach of warm weather, they were as lively as ever.

The only instance, in any way, against the above observations

occurred in the great Marshes of Lake Erie. During a severe winter the mud and water froze to a great depth. The consequence was that when the marshes thawed out the shallows were covered with dead turtles, snakes, frogs, etc. The unanimous opinion of the Corps of Engineers was, that the cause of this wholesale slaughter of the reptiles was some poison permeating the marshes, doubtless generated by the slow approach of spring. There may be such a thing as being frozen too effectually, however, for a good condition of torpidity. As a final instance I may note the return of frogs from their winter's quarters, at Camden, N. Y. Hundreds of these near this place came up from the earth in a shallow marsh, tumbling, leaping, and capering about, some of them appeared belly up, others with huge bags protruding from their mouths. They were all in a weak, half-sensible state, but gradually regained strength in the sunlight.

It is evident that animals do not assume a torpid state in warm weather, since no instance of the kind is known or recorded. The above instances seem therefore applicable to the previous conclusion that animals in a torpid state may be aroused by an increase of temperature, or in other words, torpidity is but a lowered temperature, sometimes to the freezing point.—*William Hosea Ballou.*

Migration of Dragon Flies.—On the 2d of June, in Weymouth, Mass., I observed what seemed to be a concerted migration of dragon flies, and should be glad to be informed whether such movements are of regular occurrence, and if they are, what is the explanation of them? I was sitting in a pasture near the edge of a wood (the wood being, perhaps, half a mile deep), at about eight o'clock in the morning, when I first became aware of what was going on. The flies came from over the trees, and generally on reaching the pasture, dropped to within five or ten feet of the ground, although many flew much higher and some went straight across the pasture at an estimated height of forty feet. All, with rare exceptions, kept a steady course due west, as though they were moving to some appointed rendezvous. They came in sight somewhat as waves come upon the beach—one minute there were none, and the next there were two or three or half a dozen together. I watched them for three hours or more, and in the afternoon followed in their train across two roads and some pasture lands to the edge of another wood. When they reached this wood they seemed, many of them, a little at a loss how to proceed, but soon mounted into the air and sailed over the trees out of sight. I then visited a small pond in the vicinity and took notice that they flew across it and kept on in their westerly course. As to the width of the column, I only know that it was at least a quarter of a mile. They were still flying at a little before eight o'clock in the evening, when it was almost too

dark to see them. The two following days were cold and stormy, but on the 5th a few were still straggling across the fields.

On the evening of the 23d inst., while crossing Boston Common, I saw what seemed to be a similar migration, and in this case also the course was west.—*Bradford Torrey.*

TRICHODINA PARASITIC ON THE GILLS OF NECTURUS.—I have to record a new habitat for this interesting ectoparasitic genus of Infusoria. I was recently searching the gill-filaments of a Necturus (which had died a few hours before in the attempt to swallow a young catfish) for specimens of a Polystome which I have described as occurring there, when I noticed the remains of a considerable number of Infusoria belonging to this genus. Only the aboral end of the body with its hooks and chitinous frame remained, the softer oral end being already disintegrated. I did not succeed in identifying it with *T. pediculus*, the ectoparasite of Hydra, which has been so admirably described by James-Clark (Mem. Bost. Soc. Nat. Hist., Vol. I, No. I), but it is possible that the examination of fresh specimens would prove it to belong to this species, which has also been indicated as occurring in the allantoid bladder of certain European newts (Busch, Müller's Archiv., 1855).

Since writing the above I have had the opportunity of examining a fresh Necturus with the result that its Vorticellidan parasite also occurs in the urinary bladder. It is identical with the Hydra parasite, *Trichodina pediculus.*—*R. Ramsay Wright, University College, Toronto.*

ZOÖLOGICAL NOTES.—The last number (3 of Vol. III, Part. I) of the Memoirs of the Boston Society of Natural History contains an elaborate essay, by S. H. Scudder, on the palæozoic cockroaches, being a complete revision of the species of both worlds, with an essay towards their classification. This work of 111 pages is illustrated by six excellent plates. It appears that the palæozoic cockroaches are, like many other groups of animals of the palæozoic age, old fashioned, obsolete forms which have been replaced by more modern types, and we may add that the existing cockroaches are to be congratulated that the shades of their ancestors have been thus recalled from their tombs and passed in review in a long and orderly procession.——Dr. Hagen is sanguine that noxious insects, such as the potato beetle, cotton worm and Rocky Mountain locust can be kept under, if not exterminated, by the use of yeast fungus; we hope that these fungi will take the place of Paris green as an insecticide, and trust another year to see experiments carried out upon an extensive scale; we know that myriads of insects, such as the house fly, are killed by fungi; why not myriads more, provided that the weather be sufficiently damp and warm for the growth of the fungus spores, a point not noticed by Dr. Hagen. In hot, dry

weather the fungus would probably not have a deadly effect.——The attention of our readers has never been called to Baron Osten Sacken's second edition of the Catalogue of the described Diptera of North America, published about a year since by the Smithsonian Institution. It is invaluable as a work of reference.——American students in foreign laboratories do work of as high an order as their German, French or English fellow students of the same schools. No better work in embryology has been done than that comprised in Mr. C. O. Whitman's essay on the embryology of the little leech, Clepsine. We now draw attention to the able paper of two recent Princeton graduates, Messrs. Scott and Osborn, who have worked up the early development of the common European newt, published in the Quarterly Journal of Microscopic Science for July last, and now issued in pamphlet form.

ANTHROPOLOGY.[1]

RAU'S PALENQUE TABLET..—The latest contribution to knowledge issued by the Smithsonian Institution, is No. 331 of its publications, a quarto of seventy-six pages, by Dr. Charles Rau, on the Palenque Tablet in the United States National Museum. The contents of the work are as follows: "Chapter I.—History of the Palenque Tablet; Chapter II.—Explorations of Palenque; Chapter III.—The Temple of the Cross; Chapter IV.—The Group of the Cross; Chapter V.—Aboriginal writing in Mexico, Yucatan and Central America; Appendix.—Notes on the Ruins of Yucatan and Central America." In the first chapter we have a minute relation of the manner in which the tablet found its way from the Temple of the Cross to its present position in the National Museum. In the second chapter Dr. Rau gives a narration of the various explorations of these interesting ruins. The name Palenque is derived from a village about eight miles away, called Santo Domingo del Palenque. The ruins were discovered in 1750, by a party of Spaniards, and surveyed for the first time by order of Ramon de Ordoñez in 1773–1784. The first exploration which lead to any result was that of Capt. Antonio del Rio in 1787; his manuscript was published in London, in 1822, with drawings from Castañeda, the artist of Dupaix. Capt. William Dupaix, in 1808, visited Palenque, with an artist named Castañeda. The MSS. and drawings will be found in Vols. IV, V, VI, of Kingsborough. Baron de Waldeck lived two years at Palenque making surveys and sketches, 1832–4. His plates, with text by De Bourbourg, was published in Paris, in 1866, by the French Government.

When Dupaix visited Palenque the three slabs constituting the Group of the Cross were all in place. But at the time of Waldeck's visit, the right one, now called the Smithsonian Tablet,

[1]Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

was in fragments on the floor; the middle one had been carried off to the banks of the river by a vandal who wished to adorn his house with it; and the one on the left was in its original position, which it now occupies. Stephens and Catherwood visited the spot in 1840, and were entertained by Mr. Charles Russel, our counsel at Laguna. They made drawings of the ruins, and shortly after their visit the fragments of the right hand slab were sent to the National Institute in Washington, where it arrived in 1842. The site has since been visited by Arthur Morelet in 1846, and M. Désiré Charnay, for the French Government, in 1857. The tablet was transferred to the Smithsonian Institution 1858, and in 1863, while making a cast for Prof. Henry, Dr. George A. Matile discovered that this was the missing slab from the Palenque group, not drawn by explorers after Dupaix. It was broken again after Dr. Matile's cast was made, but reconstructed and set in its present frame, from which Dr. Rau's photograph was taken. Whatever doubt may have remained after Matile's argument, is now dispelled by reference to the outline plate of Dr. Rau's work, in which the whole Group of the Cross is again restored.

The occurrence of the sign of the cross in America anterior to its discovery by Columbus, has been the marvel of arçhæologists. But the fact of its appearance in many places where Christian influence had never been felt, compelled the student to look for other motives in its existence. The whole subject is reviewed in Chapter IV, pp. 39–46. Of equal interest with the allegorical sculpture is the subjects of the hieroglyphics, on which Dr. Rau has bestowed a great deal of faithful study. The supposed key to their interpretation is a MSS. found in the Royal Library of Madrid, by Brasseur de Bourbourg, in 1863, which is a copy of one composed by Diego de Landa, in 1579, and giving, among other things, an alphabet of thirty-three signs. It will be remembered that a similar old MSS. is mentioned by Sr. Orozcoy Berra, in Anales del Museo Nacional de Mexico, containing the Lord's Prayer in symbols, partly Aztec and partly ecclesiastic. All attempts to interpret the Central American glyphs and manuscripts by Landa's alphabet have proved failures. Dr. Rau, the most cautious of theorists, does not attempt a solution; but on page 61 gives a diagram of his outline plate, by which every glyph on the tablet may be easily referred to (it is a pity that the letters and figures do not occur on the margin of the plate itself). On pages 62 and 63, some of the glyphs are analyzed, and the places where the elements are to be found, are indicated. The author concludes that the analogies between Landa's signs and the glyphs warrant the suggestion that the inscriptions constitute a chronological record of some kind. On pages 53 and 64 Dr. Rau corrects an error of Humboldt, Kingsborough, Stephens, and others, as to the close relationship between the

Aztecs and ancient Mayas based on the Dresden Codex, which is clearly shown to be of Maya and not of Mexican origin at all.

On page 75 the author reaffirms the view of Stephens, Bancroft, as well as his own, "that the Yucatan structures were built by the Mayas, the direct ancestors of the people found on the peninsula at the Conquest, and of the present native population."

ANTHROPOLOGICAL NEWS.—Mr. H. R. Howland is the author of a brochure entitled "Primitive Arts and Modes of Life," the substance of which was read before the Buffalo Society of Natural Sciences, March 15, 1879. The object of the author is to show how, in simple beginnings, out of the dire needs of humanity, have been born the arts of life as known to civilized man; how with patient toil he has wrought out, by means God-given, the problem of his growth and their advancement.

A printed notice of four pages, announces the formation, in Boston, of the "Archæological Institute of America," for the purpose of promoting and directing archæological investigation and research, by sending out expeditions for special researches, by aiding the efforts of independent explorers, by publication of reports of the results of expeditions which the institute may undertake or promote, and by any other means which may from time to time appear practicable. The institute consists of life members contributing at one time $100, and of annual members paying $10 per annum. Membership is now open to all persons interested in the objects of the institute, and who may desire to join it. The call is signed by Francis Parkman, W. W. Goodwin, Alexander Agassiz and other distinguished scholars. Prof. C. E. Norton is president, and Mr. Edward H. Greenleaf, Museum of Fine Arts, Boston, Mass., secretary, to whom all communications should be addressed.

"The Aboriginal Soapstone Quarries in the District of Columbia" is the title of a brochure from the Twelfth Annual Report of the Peabody Museum of Archæology and Ethnology, by Elmer R. Reynolds. The discovery of the soapstone quarry at Chulu, Amelia county, Virginia, seems to have kindled a great deal of enthusiasm in our archæologists with reference to aboriginal quarrying and mining. Dr. Reynolds is an indefatigable hunter, and his success in discovering soapstone quarries in the District of Columbia, almost under the shadow of the National Museum, is graphically described in the pamphlet before us.

The Society of Biblical Archæology has for its object the study of the languages, remains and natural history of those lands with which the Jews were associated, from the earliest times to the close of the canon of Scriptures, with a view to the better understanding of the Old and New Testament. In point of fact the history of the Jewish race demands an intimate acquaintance with the civilizations of the Nile valley, Mesopotamia, the slopes of the Lebanon range, and, in latest Biblical times, of that of Greece

and Rome. The society has for its president Dr. Samuel Birch, the Egyptologist, and includes many of the most distinguished men in England among its members. The honorable secretary for foreign correspondence is the Rev. A. H. Sayce. An acquaintance with its publications is indispensable to those who wish to pursue the study of Oriental archæology.

The first number of Vol. IX of "The Journal of the Anthropological Institute of Great Britain and Ireland, August, 1879," contains the following papers: Exhibition of the cranium of a Native of one of Fiji islands, by Prof. Flower; The Primitive Human Family, by C. Staniland Wake; On an *Echelle de Couleurs*, published by the Société Sténochromique of Paris, by E. W. Brabrook; Remarks on the Geographical Distribution of Games, by Edward B. Tylor; On some Rock Carvings found in the neighborhood of Sydney, by Sir Charles Nicholson; Relationships and the names used for them among the peoples of Madagascar, chiefly the Hovas, together with observations upon marriage customs and morals among the Malagasy, by the Rev. James Sebree, Jr.; History of the South-western Barbarians and Chaou-Seën, translated from the "Tseen Han Shoo," book 95, by A. Wylie, Esq.; Rag-Bushes and kindred observances, by M. J. Walhouse (See "Fetish or Rag-Bushes in Madagascar," *Saturday Magazine*, Nov. 22).

Mr. Wake's paper is a continuation of the author's discussion of a kindred subject in Vol. VIII, of the *Journal*. After reviewing Mr. McLennan's theory of the origin of society in polyandry, he adds, "We cannot suppose that the primeval group of mankind consisted only of a woman and her children; and if the woman had a male companion, we cannot doubt, judging from what we know of savage races, that he would be the head and chief of the group. * * * Self interest chiefly would govern the father in connection with the marriage of his daughter. Whether the marriage was to be a permanent or a terminable engagement, he would stipulate that they should continue to live with or near him, and that her children should belong to him as the head of the family group. In this case, not only would the children form part of the family to which their mother belonged, but the husband himself would become united to it, and would be required to labor for the benefit of his father-in-law. When the wife left her father's house to reside with her husband, he had to purchase the privilege by giving her father and other relatives handsome presents. [This could hardly have occurred at first, when property was not held in severalty. It marks a higher step in culture]. In this case the children belonged to their father's family, and the fact of the wife going to reside among her husband's relatives meant the loss of the children by *her* father's family. The presents may, therefore, be supposed to represent the price given by a man for his wife's offspring to her relatives. Probably the wide-spread

custom of pretended forcible marriage was originally thus connected with the rights of the woman's relatives, and may have originated in the desire to obtain for nothing what could otherwise be acquired only by a purchase fee.

These rights, according to Morgan, are inheritance of the property of deceased members, reciprocal obligations of help, defence, and redress of injuries, and the obligation not to marry in the *gens*, although practically, the property was appropriated by the nearest of kin. Morgan says nothing of any right of the gens over the marriage of its members, and it would seem not to have had any voice in the matter. Reference to the custom of blood-revenge confirms the view that, for certain purposes, a smaller family group than the *gens* is recognized by the people having that organization. The example of the Polynesians, who are said not to have arisen to the conception of the gens, shows that before this was developed, not only was the *lex talionis* recognized, but the law of marriage and the rights of parents over their children were fully established. It is evident, therefore, that the primitive family cannot have originated with the gens, or clan; on the contrary, the clan was based on the family or group of kinsmen, which would be a parent, his wife or wives; their daughters, together with the husband and children of the latter.

The view of the ancient family held by De Coulange and Sir Henry Maine would be complete if it provided for the fact, that descent was originally traced by the female line in preference to the male line. The defect thus revealed will be removed if it can be shown that descent through the male is for certain purposes recognized equally with that through the female." Mr. Wake, in closing, draws attention to the important fact first noticed by Mr. Fiske, that owing to the prolongation of infancy children had to be nurtured by female parents aided by males to some extent; and to Mr. Spencer's remark that, "To the yearnings of natural affection are added in the early stages of progress, certain motives, partly personal, partly social, which help to secure the lives of children; but which, at the same time initiate differences of status between children of different sexes. There is the desire to strengthen the tribe in war; there is the wish to have a future avenger on individual enemies; there is the anxiety to leave behind one who will perform the funeral rites." Under the influence of these various ideas and circumstances, the custom of tracing kinship for certain purposes in the female line would be developed by the time that the habit had been formed of wives leaving their parents to reside among the husband's family. When this took place the custom would be fully established under the influence of polygamy, and the development of the gentile organization would almost necessarily follow. The primitive idea of kinship through the father would, however, still remain in full force with the attributes which originally appertained to it,

namely, the headship in the family group of the oldest male ancestor, whose authority is practically represented by the tribe, and the non-intermarriage of those thus connected.

GEOLOGY AND PALÆONTOLOGY.

THE WATER SHEDS OF THE STATE OF NEW YORK.—The State of New York presents two of the most remarkable water-sheds on the North American continent, if not on the face of the globe. Though situated so near one another that their extremities may be said to almost interlock, they are widely different in their physical features and distribution of water supply. One has been made the mighty servant of man and is harnessed for his bidding, while the other bids defiance, gushing forth its waters at its will, sometimes flooding a vast area of territory, and again leaving its river-beds to dry in the sun.

The most powerful of these is drained by the Oswego river. Its area contains no less than seven thousand square miles of territory. It comprises the well-known chain of lakes, some of which are of considerable size and importance—the Oneida, Cayuga, Seneca, etc., amounting to over four hundred square miles of lake surface. Besides being in themselves natural reservoirs, the State has further improved Seneca lake so as to regulate the periodical flow of the water. The average flow of the water is thus secured at about 600,000 cubic feet per minute. Twenty miles above the mouth of the Oswego river is Three River Point. From this place, down stream, there is a fall of water amounting to seventy-five feet. This space is taken up by seven dams erected and maintained by the State. Of these, two are situated at Oswego, covering a fall of forty feet. These dams accord hydraulic privileges equal to 25,000 horse power. But a moderate outlay is required to keep the flow in the river near the average for the year. 75,000 cubic feet of this water supply are in actual use in Oswego, where a canal is provided for the reception which furnishes fifty runs of first class water and over seventeen of the second class.

Two dams are situated at Fulton with 20,000 horse power. At this point the water privileges are easiest available, although Oswego has the greater representation of industries.

The Oswego River water shed produces clear cold water, which is perfectly under control of man, no matter what the circumstances or exigences. The river bank forms a line teeming with industries, with millions of dollars of money invested. This water supply never endangers the lives of citizens or encroaches on their property, but on the contrary, affords a roadway for inland navigation through the canals which it feeds.

Not so the other subject of this paper. Situated on the highest point in New York, among the Adirondacks, it submits to no governmental check, but ejects its turbid waters, dashing down

athwart and over precipices, which in spring time bear before them bridges and valuable property, not to say the lives of mankind.

This water shed covers an area of 2000 square miles. It comprises not less than five hundred little lakes and lakelets, some of which are said to be as large as Cayuga. 4326 feet above the sea level a little lake known as "Tear of the Clouds" starts the Hudson marching onward to the sea.

Here also rise the Moose, Beaver, Oswegatchie, Gross, Raquette, St. Regis, Salmon, Au Sable, Bouquet rivers and many other streams. Could the streams have a uniform flow during the year, the volume of water emitted would be enormous for economic use. But though violent in time of flood they are quite low, not to say often nearly dry, in summer time.

Strange as it may seem, these rivers are scarcely of use as bearing rich deposits for the low land, like the Mississippi, Missouri, etc. The region from whence they emanate is peculiarly hostile to cultivation, and has resented all attempts at settlement and immigration, and gives no return for the careful sowing of seed.

The waters afford few privileges of navigation to the hewer of timber or the excavator of ores in the mountains. They form, however, the fishing ground of America, and yield an abundance of the best of the finny tribe. Its mission in futurity is now foretold as the solving of the problem of water supply to fifty millions of people who may possibly inhabit the Mohawk valley. For the present it is to gratify the pleasurable longings of mankind. The Empire State has, therefore, two grand water sheds, the one for the accumulation of untold wealth and the other for its dissipation. But what is an Empire without unlimited resources?—*W. H. Ballou.*[1]

Geological Survey of New Zealand.—Dr. Hector's Progress Report for 1878–9, contains a synopsis of the classification of the formations of New Zealand, of which we present a summary: 1. Post-tertiary, including Moa beds, Alluvia and Raised beaches, Moraines, etc. 2. Pliocene, 1500 feet, with three divisions, Terrace plains, Pumice sands and Lignites, Kereru Rotella beds, etc. 3. Upper Miocene, 500 to 1000 feet, including Wanganani beds, Manawatu gorge, Castlepoint, Toerua and Ross, and Waitotara and Awatere beds. In this formation 125 species of Mollusca have been found, of which 120 are found in the existing seas. 4. Lower Miocene, 1000 to 1500 feet, containing 110 extinct marine forms and 55 existing species; divisions two, Mangapokeha valley and the Taipo Awainoa and Pareora beds. 5. Upper Eocene, 500 to 700 feet, with three divisions, Mount

[1] I acknowledge the valuable assistance of Mr. Chas. Rhodes, a noted lawyer of Oswego, and Prof. Calvin, of the State Survey, in the preparation of this article.

Brown beds, Hutchinson's Quarry beds and Nummulitic beds. Intense volcanic activity prevailed during this period in both islands, and the calcareous strata are frequently interbedded with contemporaneous igneous rocks and tufas, and in the North Island are often replaced by wide-spread trachyte flöes and volcanic breccias. 6. Cretaceo-tertiary, 2000 to 5000 feet, with seven divisions, Gray marls, Ototara and Weka Pass stone, Fucoidal greensands, Amuri limestone, Chalk marls and chalk with flints, Marly greensands, Island sandstone (Reptilian beds) and black grit and coal formation. The marine fossils include, besides well-marked greensand forms such as *Ancyloceras*, *Belemnites* and *Rostellaria*, a number that have still a marked affinity to the Tertiary fauna. Saurian bones occur of the genera *Plesiosaurus*, *Mauisaurus*, *Liodon*, &c., in this part of the formation; but they have only been found as yet over a limited area on the east side of the South Island. 7. Lower Greensand, 500 feet, with two divisions, Amuri group on east coast, Bituminous coals on west coast. 8. Jurassic, 3000 to 5000 feet, with three divisions, Mataura series, Putataka series, and Flag Hill series. The Flag Hill series, which is principally developed in the Hokanui range, Southland, contains fossil plants in its upper beds, which are especially interesting, from at least one species being identical with a plant found in the Ramahal beds of India, which are considered to be of Liassic age, viz: *Macrotæniopteris lata*, with which several others are associated, six of which have been identified. 9. Lias, 2000 feet, with one division, Catlin's river and Bastion series. 10. Trias, 5000 to 8000 feet, with three divisions, Otapiri series, Wairoa series and Oreti series. The Otapiri series is remarkable for the mixed character of its fossils, which, however, contain many forms identical with those from the Rhætic formation of the European Alps. The fossils are chiefly Permian and Triassic forms, but a *Pentacrinus* also occurs, which resembles the Jurassic species. 11. Permian, 6600 to 7000 with one division, the Kaihiku series. 12. Lower Carboniferous and Upper Devonian, 7000 to 10,000 feet, with two divisions, Maitai series and Te Anau series. 13. Lower Devonian, 5000 feet, with one division, the Reefton beds. 14. Upper Silurian, 3000 feet, with the Baton River series. 15. Lower Silurian, 7000 to 10,000, with one division, Mount Arthur series. Below this horizon the quartzite and gneissic granite are found in the mountain ranges.

Hill's Kansas Explorations.—During the past year Russell S. Hill, of Philadelphia, continued his explorations of the Loup Fork formation of Kansas and Nebraska. He obtained fine specimens of the large mammals discovered last year, especially of *Mastodon campester* and *Aphelops fossiger*, and added representatives of groups not previously known from this horizon. He discovered the pharyngeal bones of Cyprinid fishes, probably of the genus *Albunops*, also salamanders and *Anura*. There are also

Lacertilia and snakes, some of the latter *Crotalidæ*, as indicated by the characteristic maxillary bone, with its teeth. Specimens of *Procervulus furcatus* with a burr on the horn, show that this species did not differ from *P. necatus* in this respect; also that the *P. ramosus* is distinct from it as a species. In Nebraska Mr. Hill found the Ticholeptus beds containing *Leptauchenia*, etc., occupying the place between the White River and Loup Fork formations already assigned them.

HULKE ON ORNITHOPSIS OF SEELEY.—In the last Quarterly Journal of the Geological Society for 1879, Dr. J. W. Hulke discusses the characters of the huge Saurian named *Ornithopsis hulkei* by Seeley. He identifies with it the *Chondrosteosaurus* of Owen and the *Eucamerotus* of Hulke, but regards the American *Camarasaurus* as distinct. He figures a centrum remarkable for the extent of its lateral excavations, and of more elongate form than the corresponding ones of *Camarasaurus*. He points out the existence of the hyposphen in *Ceteosaurus oxoniensis* and in *Megalosaurus* as figured by Phillips, using for it the term zygosphen, which is, however, homologically a different structure.

FILHOL ON THE FAUNA OF ST. GERAND LE PUY.—The region of the Allier, Puy de Dome and Haut Loire, has for years furnished beautiful specimens of extinct vertebrates to the geologists of France, beginning with the time of Cuvier and De Blainville. Dr. Filhol has recently reviewed the work hitherto done in this field, and with the aid of much new material, which includes that obtained by Dr. Alphonse Milne Edwards, has commenced the publication of a detailed monograph. The first part, issued in the Annales des Sciences Geologiques, contains descriptions and figures of three species of *Chiroptera*, one of *Insectivora*, four of *Rodentia*, twenty-six of *Carnivora*, and five of *Artiodactyla*. The elucidation of this fauna is of interest to American palæontologists, since it corresponds approximately in time with the Truckee or Oregon division of our White River fauna. The faunal differences are as numerous as the resemblances. In France *Canidæ* abound, but they are mostly *Amphicyons*, not *Canis* nor other genera found in Oregon. Weasels are much more numerous than in America. There is a near affinity between Filhol's genus *Proælurus* and our *Archælurus*, though the two are distinct. Other forms of *Felidæ* are not recorded. The *Artiodactyla* are *Cænotheria*, which are abundant in species and individuals. The fullness of M. Filhol's descriptions makes them of much value to science, and the light he throws on questions of synonymy is an important acquisition. We can only wish that he could consult euphony more frequently in the construction of new generic names.

NOTES ON SABRE-TOOTHS.—The large species described in the December number of this Journal as *Hoplophoneus platycopis* turns out to belong to a new genus, which has a premolar tooth addi-

tional to the number usual in sabre-tooths. It agrees with *Dinictis* in this respect, and in its formula Pm. $\frac{3}{3}$, M. $\frac{1}{1}$, with that I assigned to *Daptophilus*. The latter however appears to have been based on an immature *Dinictis*. The new genus may be called *Pogonodon*.

Nearly the smallest of the Oregon sabre-tooths is probably undescribed. It is represented by the greater part of a skull with parts of all the teeth of one side. Its brain case is relatively large, and the sagittal crest small; the occiput is wide and vertical. Post-orbital process robust and prominent; mastoid and glenoid processes elongate. There is but one, a small premolar in front of the sectorial, and it has a very prominent heel. The sectorial has a prominent anterior lobe, showing that the species is probably a true *Machærodus*. The tubercular is very small. The canines are relatively very large; their crowns are not preserved. The front is slightly protuberant on each side of the middle line and then descends steeply to the orbit; sagittal crest horizontal. Length of cranium (axial) M. 0.120; from muzzle to orbit .045; vertical diameter of orbit .025. Long diameter of canine .015; length of diastema .011; of premolar .006; of sectorial .015; width between posterior external angles of sectorials .056. The species may be called *Machærodus cerebralis*.—*E. D. Cope*.

GEOGRAPHY AND TRAVELS.[1]

AFRICAN EXPLORATION.—The *Henry Venn*, a steamer belonging to the English Church Missionary Society, started from Lukoja, at the mouth of the Benué, on July 8, 1879, to ascend that stream as far as practicable.——The *Academy* notices a two years' exploration of the river Gambia, made by Mr. Frederic Speer, in the course of which he penetrated higher up the stream than any European had ever done before. Though unable to take observations, he has taken compass bearings and laid down the upper course of the stream with considerable accuracy. He thinks British traders would be able without much difficulty to establish a valuable trade with Timbuktu and the upper Niger. A similar report is made from the upper Volta, which was visited recently by M. Buss, a missionary, who met with a friendly reception at Salaga, the chief town of that region, containing about 50,000 inhabitants.——Herr Schütt, whose explorations in Central Africa were noticed in our number for May, 1879, has returned to Europe with large natural history collections and carefully drawn maps of the region traversed by him, which included a large tract of hitherto unknown country between the Kwango and the Kassai rivers, or between about 18° and 22° E. longitude, part of which is under the rule of the famous Mwata Yanvo. He has made some important discoveries concerning the intricate hydro-

[1] Edited by ELLIS H. YARNALL, Philadelphia.

graphy of the Congo water shed. He met with four tributaries to that river lying between the Kwango and the Kassai, viz., the Kwango, Marata, Cinlu and the Kwanger rivers. He has laid down the Kassai from 8° S. lat., to about 6° S. lat., but was stopped by king Mai, when within two days of the great waterfalls on that stream. The Kassai is known as the Zaïre from 8° S. as far as 4° S. Mucarouba is the native name for the lake heretofore called Sankowa, and it is situated in about lat. 5° S. A tribe of dwarfs live near it.——The former companions of Maj. Serpa Pinto, Messrs. Ivens and Capello when last heard from were in the district called Duque de Braganza, unable to proceed further in their attempt to trace the Kwango down to its junction with the Congo for want of means. The Portuguese government has been asked to aid them.——A mission station has been established by a French priest, Pere Duparquet, in Ovampoland, a tract of country south of the river Cunene, between 14° and 18° E. long.——Dr. Emil Holub has recently returned to Europe after seven years passed in Southern Africa. Born in Bohemia in 1847, he very early manifested great interest in natural history and geography and especially in African exploration. After receiving the degree of M. D. at Prague, in 1872, he started for Africa with a total capital of £53. He succeeded in reaching the South African diamond-fields and supported himself and earned sufficient to pay the expenses of his three journeys by his medical practice there. He has explored the country north and south of the Zambesi and studied the habits of the Matabele, the Marutsi, Hottentots, Bechuanas and numerous other tribes, living among them as their guest, and gaining their confidence by curing their sick. His last journey was the most important, lasting for twenty-one months, during which he accurately surveyed the country from the Diamond fields to the Zambesi, and the Zambesi from its junction with the Chobe to the Barotse country.

His map of the Zambesi is on a large scale, showing every island, creek and rapid. "To show the difficulties of this survey it may be mentioned," says a writer in the London *Times*, "that owing to the loss of his Nautical Almanac his sextant was useless and the bearings had to be taken by compass observations every three hundred yards, while the distances amounting in the various surveys to over 2,000 miles, were determined by *stepping*. That is the explorer counted every step he took during a twenty-one month's walk. He arrived at Muchela Amsinga tired and unwell, but still full of pluck and hoping to cross the continent and emerge at Loanda. Then fever came on and his best canoe containing all his gunpowder and, worse than all, his quinine, sank in a rapid. He still pushed on, but at the Naverbine cataract he succumbed, and was carried back insensible by his native servants to lie ill during a period of sixteen months."

On arriving at Cape Town on his return, he was most warmly

received by the governor and the public. He has also received a medal from the Vienna Geographical Society, and many distinguished honors since reaching his native land. In an interesting notice published in the *Athenæum* (October 4, 1879,) Col. Yultes states that Dr. Holub has brought with him, besides a few surviving animals, forty-nine cases of collections containing minerals, fossils, botanical preparations, and herbaria, seeds and fruits, fishes, bird-skins, nests and eggs, reptiles and insects, including some thousands of beetles, horns and skins of mammals, anatomical preparations, a large collection of ethnographic objects and a number of the famous "Bushmen engravings" on stone, etc. There are, besides in Prague, fifty-six cases containing the fruits of the earlier journeys. There are also extensive topographical sketches, several hundred drawings of botanical, zoölogical and ethnological interest. Dr. Holub hopes to obtain funds in Europe to form an international expedition of twelve members from as many different nations for the special purpose of opening Central Africa towards the south and east, and to facilitate the colonization of the district between the Vaal river and the Zambesi.——The Royal Geographical Society has received a letter from Mr. Thomson in command of the expedition to Lake Nyassa dated August 30th, at Mkubwasanya, in Uhéhé, a tract of country north of the Kondi mountains, at an elevation of 6000 or 7000 feet above the sea and about six days' journey from Lake Nyassa. ——The London Missionary Society has lost another of its members by death at Ujiji, the Rev. A. W. Dodgshun. The company which left Zanzibar under the leadership of the late Dr. Mullens, had reached Mirambo's capital, in Unyamwezi, at last accounts going from Mpwapwa by a new and unexplored route.——The Portuguese authorities are contemplating the construction of a road from Quillimane to Lake Nyassa.——The Indian elephants sent out by the King of the Belgians have reached Mpwapwa; all in good health except one which died shortly after arriving there. Each elephant carried about ten hundred-weight. In the district where the tsetze flies abound the animals were often covered by them without feeling any the worse for it. They are expected to be used at first for catching and training African elephants.——The Portuguese are about establishing a colony at Zumbo, fifty miles from Tete, and the government has made extensive grants to the company formed for that purpose.——The first Belgian expedition was expected to reach Tanganyika towards the end of June last. M. Cambier has been instructed to push on to Nyangwe on the Congo. His party ultimately expected to enter into Lunda or Ulunda west of the Congo, and are to be furnished with supplies from the expedition now under command of Mr. H. M. Stanley.

The second expedition under M. Popelin has been directed to establish its station on the eastern shore of Lake Tanganyika, in a bay some little distance south of Ujiji. This company reached

Mpwapwa on August 15th last, and expected to commence the journey across Ugogo on September 3rd. Mr. Stanley left Sierra Leone on September 3rd, for Banana (Banza?) on the Congo.——According to the *Academy* King Mtsesa has recently showed himself less friendly to the Missionaries of the English Church Mission, accusing them of complicity with the Egyptians. The Missionaries have been reinforced by the arrival of three more by way of the Nile via Magungo and the Albert Nyanza, and of two others by the lake from Kagei at the southern extremity.——Menelek, king of Shoa, has written to the Geographical Society of Paris urging the sending out of a French Mission, promising to employ all his power on their behalf. The Sultan of Somali land, on the western coast of the Gulf of Aden, has also invited foreigners to visit his dominions.——Gessi Pacha has succeeded in capturing the last refuge of the slave traders in the Soudan. Over 4000 have been expelled from the country and twenty-five slave caravans of between three and four hundred slaves each have been captured. ——Dr. Wilhelm Junker has returned recently to Europe after three years spent in explorations on the upper Nile. Dr. Schweinfurth writes to the *Athenæum* (August 23, 1879.) giving an account of his travels, illustrated by a small map of the Welle basin. Dr. Junker has brought back with him and given to the Russian Academy of Sciences the largest and best ethnological collection yet obtained in these regions. His careful surveys throw a flood of light upon the water shed separating the Nile from the Welle, and present a basis for mapping an area of four square degrees. He has also made a survey of the lower Sobat. The results of his investigations in the district lying between the Welle river and the Bahrel Ghazel are given in much detail, and the corrections necessary in Schweinfurth's own itinerary indicated. Dr. Junker reached his furthest point in lat. 20° 30′ N., where at a distance of twenty miles he saw a range of high mountains identified by him as the Blue mountains of Baker to the west of the Albert Nyanza.

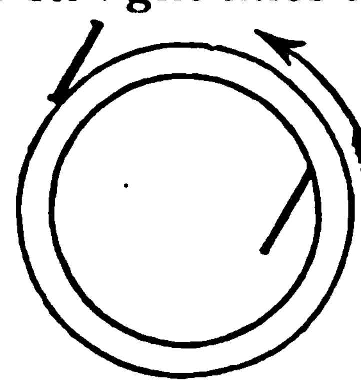
MICROSCOPY.[1]

Thin Glass Slide Troughs.—These are made of glass slips, three inches by one and one-third inches, to which are cemented slips of thin glass two inches by one inch, out of which a semicircle of three-quarters of an inch radius has been cut, and then covered with another thin glass two inches by one inch. It is well to have an assortment of these, of different thicknesses or depths, and for those of greater depths it is more convenient to make the distance-plates of vulcanite instead of glass. These troughs should always be washed out directly after use.

Preparations of Crystals for the Polariscope.—After preparing crystals, dry, in Canada balsam, and in castor oil, it

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

occurred to me to attempt to preserve them in their own mother liquor. To do this paint on a slide a thin ring of gold size, whose entire diameter shall equal that of the cover glass. To make the edges of the ring smooth and true hold the flat edge of a small chisel against them at the points indicated by the straight lines in the figure, whirling the turn-table in the direction indicated by the arrow. As soon as the ring is finished heat it over the flame of a lamp until it becomes brown. Put into a test tube a little salycine, tartaric acid, prussiate of potash, or other substance adapted for examination with the polariscope, add water and apply heat until the solution is of such strength that crystals will form in it only when quite cold. Coat the ring, already hardened, with a little fresh size, and likewise the edge of the cover glass. Put the slide and cover glass thus prepared, on the hot plate for a few minutes and then pour a few drops of the boiling solution from the test tube into the cell and apply the cover glass, immediately pressing it down gently with a dry cloth which will absorb the superfluous liquid. Touch the edge of the cover glass with gold size and then transfer to the turn-table and finish. If the above directions have been followed correctly the cell will contain a clear liquid which begins to deposit crystals as it cools. Transfer the slide to the stage of the microscope soon enough to watch this process. Without the aid of the polariscope it is of interest, but with that accessory the spectacle presented is exceedingly beautiful.



After standing for some time however, the crystals appear to lose their sharpness and perfection of form. They may be restored by a fresh application of heat sufficient to cause them to dissolve and enter upon new forms of combination. As a means of observing the process of crystallization this method appears to be the best, and many of the results as respects brilliancy of color and perfection of outline are unsurpassed. I would recommend however, that those who have not tried it, should make a moderately strong solution of salycine or tartaric acid in boiling water and pour it over a warmed slide, draining off the greater part immediately. When crystallization ceases put a drop of Canada balsam in the center of the slide and apply a cover glass. Examine, and if found satisfactory, harden the balsam and finish in the usual way. Having once learned these processes, there is no limit to the range of experiments that may be made. For instance, a strong solution of santonine in chloroform gives very fine crystals which are quite permanent and brilliant when mounted dry. It should be noted that the quantity and strength of the solution employed will modify the results obtained, also agitation of the fluid whilst evaporating will in some instances introduce crystals of an entirely different form from those obtained when it is permitted to remain undisturbed.—*M. A. Verder.*

Separating Foraminifera from sand.—If you throw dried sponge sand into water, slowly, all the foraminifers will sink, and sand will float on the water. A slide dipped under the floating film of grains will bring up only sand. You can safely skim off and throw away all that does not sink with a little stirring. Then the sunken part should be dipped out, about a dessert-spoonful at a time, into a small saucer, and water enough to just fairly cover them put in, and all floating grains stirred down. Then by a circling movement of the hand the foraminifers will be got to the top, and by gradually tipping the saucer and slowing up the movement they can be worked to one edge of the little pile of sand, and thence carefully dipped up with a rubber bulb pipette. In this way they are got almost pure. Only a little sand must be washed at a time, or not all the foraminifers will be got out, and very little water must be used or sand will get mixed with them. Much water moves the light sand, but a shallow wave seems not to stir it, but yet rolls the shells along—*C. M. Vorce.*

Naturalists' Directory.—The Naturalists' Directory for 1879, recently published by S. E. Cassino, at Salem, Mass., contains by far the best register of American microscopists yet published. It will be found especially useful to the microscopists who desire to arrange for exchanges in different parts of the country.

——:o:——

SCIENTIFIC NEWS.

— Recent arrivals at Zoölogical Garden, of Philadelphia: 1 sandhill crane (*Grus americana*); 2 cheetahs (*Felis jubata*) ♂ ♀ Africa; 1 sun bear (*Helarctos euryspilus*) Borneo; 1 Chacma baboon (*Cynocephalus porcarius*); 2 electrical eels (*Gymnotus electricus*) and 2 red-crested cardinals (*Paroaria cucullata*) South America; 3 mule deer (*Cervus macrotis*) and 1 fallow deer (*Dama vulgaris*) Europe, bred in the garden; 7 mandarin ducks (*Aix galericulata*), China; 1 rose-crested cockatoo (*Cacatua moluccensis*); 78 finches, of the following species: *Amadina fasciata*, *A. bicolor*, *Munia undulata*, *M. maja*, *M. acuticauda*, *M. malacca*, *Estrelda amandava* and *E. melpoda;* 2 American elk (*Cervus canadensis*) and 2 Virginia deer (*Cervus virginianus*), bred in the garden; 1 Marabou stork (*Leptoptilus crumeniferus*), West Africa; 2 black-tailed parrakeets (*Polytelis melanurus*), Australia; 1 grand galago (*Galago crassicaudata*), East Africa; 1 Ducorps cockatoo (*Cacatua ducorpsi*), Solomon Islands; 1 lesser sulphur-crested cockatoo (*Cacatua sulphurea*), Moluccas; 1 white goshawk (*Astur novæ-hollandiæ*, Australia; 2 hyacinthine porphyrios (*Porphyrio hyacinthinus*) Europe; 2 white storks (*Ciconia alba*), Germany; 1 armadillo (*Dasypus novem-cinctus*), Texas; 4 collared peccaries (*Dicotyles torquatus*); 5 woodchucks (*Arctomys monax*) and 27 com-

mon opossums (*Didelphys virginianus*), bred in the garden; 32 *Amblystoma mavortium* and 10 of the siredon form of that species from Wyoming; 2 sand toads (*Bufo vulgaris*), England; 1 buffalo (*Bison americanus*), ♀ bred in the garden; 1 black ape (*Cynopithecus niger*), Phillipine Islands; 1 moor macaque (*Macacus maurus*), Borneo (?); 2 ashy-black macaques (*Macacus ocreatus*), Celebes (?); 1 African python (*Python sebæ*); 1 Egyptian cobra (*Naia haje*); 1 clapper rail (*Rallus longirostris*), New Jersey; 1 horned lizard (*Phrynosoma douglassi*); 1 rufous rat kangaroo (*Hypsiprymnus rufescens*), and 27 water snakes (*Tropidonotus fasciatus*), born in the garden; 1 rattlesnake (*Crotalus atrox*)?; parasitic jæger gull (*Stercorarius parasiticus*), North Atlantic; 1 great kangaroo (*Macropus giganteus*); 15 banded rattlesnakes (*Crotalus horridus*), and 5 water moccasins (*Ancistrodon piscivorus*), born in the garden; 1 booby gannet (*Sula fiber*), captured off Cape Henlopen; 2 common squirrels (*Sciurus vulgaris*), Europe; 1 orang-utan (*Simia satyrus*), ♀ Borneo; 1 Diana monkey (*Cercopithecus diana*), Africa; 1 saddle-billed stork (*Xenorhynchus senegalensis*), West Africa; 1 tapir (*Tapirus terrestris*) ♀; 4 Yarrell's curassows (*Crax carunculata*); 4 razor-billed curassows (*Mitua tuberosa*); 1 red-breasted swan (*Penelope pileata*), and 18 boas (*Boa constrictor*), South America; 1 eland (*Oreas canna*), Africa, and 2 black wolves (*Canis lupus ater*), received in exchange; 1 hog-nosed snake (*Heterodon simus nasicus*), and 1 rattlesnake (*Crotalus confluentus*) Colorado; 1 soft-shelled turtle (*Aspidonectes*, sp. ?); 1 Javan chevrotain (*Tragulus javanicus*), ♀ bred in the garden; 2 hawks (*Buteo*, sp. ?), Colorado.

— It will appear by the following note from Prof. Birge that we were in error as to the completeness of the series of Bronn's Klassen und Ordnungen.

"Your reviewer has apparently fallen into some errors respecting Bronn's Klassen und Ordnungen. The work is not yet 'drawing to a close.' The Amphibia are the only class of Vertebrates completed; the fishes and reptiles only just begun, while twenty-two parts have only partly finished the osteology of mammals.

"The six parts on birds, treating of osteology and part of the myology, were published nearly ten years ago and none since. Of Crustacea, the first volume is just complete, treating of the Entomostraca only. The worms and insects are not yet begun, while the earlier volumes, especially those on Protozoa and Radiata, are somewhat antiquated.

"The work is indeed invaluable, but no one should buy it in expectation of soon getting the remainder. It has been now twenty years publishing, and at the present rate will not be completed in less than twenty more. Only two volumes, that on Amphibia and the first volume on Arthropoda, have been finished in thirteen years.—*E. A. Birge.*"

— Prof. K. Ellsworth Call and Mr. Arthur F. Gray are now engaged upon a Monograph of North American *Unionidæ*, and desire to make their work complete as regards synonomy. For this purpose they desire shells from all parts of the United States, Mexico and Canada, for purposes of comparison. The shells of the Complanatus group are now desired. Liberal exchanges will be given, or shells (typical) purchased. Parties collecting specimens with soft parts, please address Prof. K. Ellsworth Call, Normal and Scientific School, Dexter, Iowa, or Arthur F. Gray, Danversport, Mass. Information with regard to peculiar forms and interesting localities will be duly acknowledged. Where possible, preserve the animal.

— The *Scientific American* for Dec. 27th, contains an article by D. C. Beard, who accounts for the sea-serpent by supposing it to be the gigantic squid which are known to inhabit the coasts of New Foundland and the high seas. We are not sure but that this is a plausible explanation, and expressed seven or eight years ago, in a communication to the Essex Institute of Salem, that the appearances referred to the "sea serpent" were, perhaps, occasioned by wounded or tired squid of colossal size, such as are known to exist in the oceans in both hemispheres. The barrel-shaped head, large eyes and trailing, undulating body, attributed to the "sea-serpent" can be explained as depicted in the *Scientific American*.—*A. S. Packard, Jr.*

— Second Session of the Chesapeake Zoölogical Laboratory.—A brief report of the work done in this Laboratory has appeared, from which we learn that twelve were present. Dr. Clarke investigated the Hydroids, Prof. Brige the development of two species of crabs, Miss Munn the development of the Ctenophoræ, Mr. Wilson verified the observations of previous writers in regard to the change of Actinotrocha into Phoronis, while Dr. Brooks studied the development of the squid and oyster and ascertained the existence of a rudimentary velum in the Cephalopoda. A brief abstract of his studies on the oyster has already appeared in the columns of the American Journal of Science and arts.—*J. S. K.*

— The report of the curator of the Harvard University Museum of Zoölogy, where geology is also taught, shows that facilities are extended to those desirous of studying lithology. The instruction given by Mr. M. E. Wadsworth during the past year, consisted of lectures upon the macroscopic and microscopic characters of the rocks and their constituent minerals, and also of field and laboratory work. Besides the study of the laboratory collections, each student had assigned to him a separate district, which he was to map, studying the characters and relations of the rocks, and collecting the necessary specimens. Of the rocks thus collected, the student was required to make thin sections and to examine them microscopically, writing a thesis upon the whole work. It was intended that the course should be sufficiently thor- [illegible] the student for practical field and laboratory research.

— Professor Geikie opened his course of lectures to his class in the University of Edinburgh, November 10th, with a very interesting account of his recent explorations in our Western Territories, a full summary of which appears in *Nature* of November 20th. He described his visit to the Yellowstone park, the Uinta mountains and other portions. His remarks on the evidences of glaciation and the superficial deposits of the West were excellent. He is now preparing an elaborate paper on the glacial phenomena which he observed, which he will offer for publication to some society or journal in this country.

— The committee of the Philadelphia Park Commission, appointed for the purpose, recently held a conference with the committee of the Permanent Exhibition Company. The former, after consideration, resolved to recommend to the commission that the order for the removal of the Permanent Exposition be revoked, on condition that the Permanent Exposition Company raise the sum of $100,000 as a working capital, and agree to conform to the terms of their lease. It is to be hoped that the commission will act on the report of the committee, and give the Permanent Exposition the opportunity to show what it can become.

— Biologia Centrali-Americana. Messrs. Dulau and Co. have commenced a splendid work under the above title, on the animals and plants of Mexico and Central America. It is edited by Messrs. F. D. Godman and Osbert Salvin, who have been collecting their materials for the past twenty-two years. It is to be issued in parts, sixty of zoölogy and twenty of botany, each consisting of about ninety-six pages of letter press, with numerous plates, many colored by hand. The colored plates issued with the first zoölogical part are said to be of remarkable beauty, delicacy and truthfulness to nature.

— Among the names of recently deceased scientists occur the names of Dr. F. Chapuis, the well known Belgian entomologist, who died at Verviers, Sept. 20th; the dipterist C. Rondani, who died at Parma, Sept. 18; and T. Chapman, who died at Burghill, Hereford, Aug. 27. October 17, A. H. Garrod, well known for his papers on the comparative anatomy of birds and mammals, died in London. He was a naturalist of much promise. The death of the French author, Jean Charles Chenu, has lately been reported.

— Prof. J. D. Dana is about to issue a new edition of his very valuable Manual of Geology. This edition will be greatly improved and enlarged and the whole subject brought up abreast of the present progress of the science. This work has occupied the greater portion of his time for several months.

— The Royal Museum of Leiden, as reported by Dr. H. Schlegel, the Director, contains, not reckoning duplicates, 7900 mammals, 50,000 birds, 2920 skeletons, and 4300 skulls. It has one collector in Madagascar and two in West Africa.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences, Dec. 15.—Mr. Isaac N. Merritt read a description of the remarkable newly-discoved Luray caverns, Page county, Virginia (with illustrative specimens).

Jan. 5.—Prof. H. C Bolton remarked on the application of organic acids to the examination of minerals (second paper).

Boston Society of Natural History, Dec. 17, 1879.—Mr. F. W. Putnam remarked on Conventionalism in Ancient American Art, illustrated by specimens of pottery from the Peabody Museum of American Archæology and Ethnology.

Jan. 7.—Mr. J. S. Diller read a paper on the Felsites and their associated rocks north of Boston. Mr. W. O. Crosby remarked on distorted pebbles in conglomerates, and Mr. F. W. Putnam read a short account of the largest mound in the United States.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

American Journal of Science, Jan. 1880.—New forms of fossil Crustaceans from the Upper Devonian rocks of Ohio, by R. P. Whitfield (describes certain Devonian Phyllocarida under the name of *Echinocaris* (new genus), and a Devonian Decapod Crustacean with the name of *Palæopalæmon newberryi*, this being the oldest genuine Decapod Crustacean yet known). New characters of Mosasauroid Reptiles, by O. C. Marsh.

Siebold's und Kölliker's Zeitschrift für wissenschaftliche Zoologie, December 12.—Studies on the organization and development of the Chalinid Sponges, by C. Keller. Structures of the Læmipoda, by G. Haller. On the morphology of the pelvic and shoulder-girdles of the bony fishes, by Olga Metschnikoff. On some octoradiate silicious sponges, and on the development of their buds, by E. Selenka.

Jenaische Zeitschrift für Naturwissenschaft, Nov. 30, 1879.—O. and R. Hertwig continue their beautiful studies on the anatomy and histology of the Actiniæ.

The Geological Magazine, Dec. 1879.—On the Parallel Roads of Glen Roy, by J. R. Dakyns.

Journal of the Queckett Microscopical Club, Nov. 1879.—On a method of resolving diatom tests, by A. Schulze. On the anatomy of Actinia mesembryanthemum, by F. A. Bedwell. On staining sections of animal tissues, by J. W. Groves (a very useful paper). On some improvements in microscopical turntables, by C. S. Rolfe.

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THE PROBOSCIS OF THE HOUSE-FLY.

BY PROF. G. MACLOSKIE, LL.D.

THE common house-fly of Europe (*Musca domestica* L.) probably includes the American as well as the old-world forms.[1] Its proboscis has attracted much attention and been the subject of

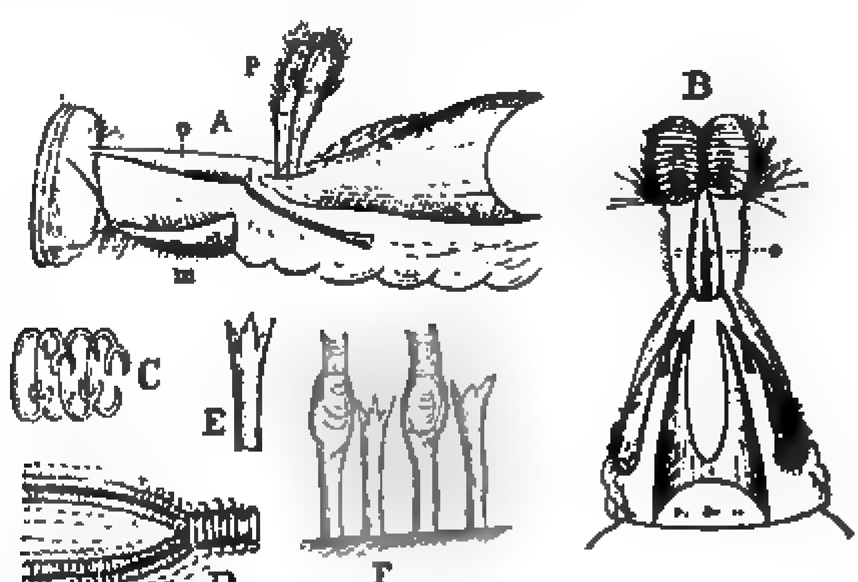

FIG. 1, *A–F*.—*A*, right side view; *B*, dorsal view of proboscis of *Musca domestica*; *C*, semi-tubes of its false tracheæ; *D*, two of the false tracheæ with wrinkled membrane between; *E*, a tooth; *F*, arrangement of teeth between roots of false tracheæ In *A* and *B*, *l* represents the tip; *o*, the operculum; *p*, the palps; *f*, the fulcrum; *m*, the mentum.

much misapprehension. I have recently been fortunate enough to find out several important points about the mechanism of this organ and the homologies of its parts.

[1] Harris had cast a doubt on this and given the American forms the title *M. harpyia*, in remembrance of his disgust at "these filthy dungbred creatures." Prof. A. S. Packard, Jr., has established their claim to a place in the Linnæan species, *M. domestica*.

Its Structure.—The proboscis consists of three divisions—base, mid segment and tip. The base, or proximal division, contains:

1. A large framework of hard dark-colored chitin (*f* in Fig. 1, *A* and *B*, represented in the margin as spread out). This has been termed the *pharynx*, or *fulcrum*, by Lowne.[1] In the natural position this fulcrum is a narrow box, open at both ends, and sending processes backwards and forwards. The distal part of its roof is left open so as to receive the mid segment in flexion. One of Lowne's terms for it (*pharynx*) is incorrect; it is rather a case surrounding the pharynx. I shall refer to it by the name *fulcrum*.

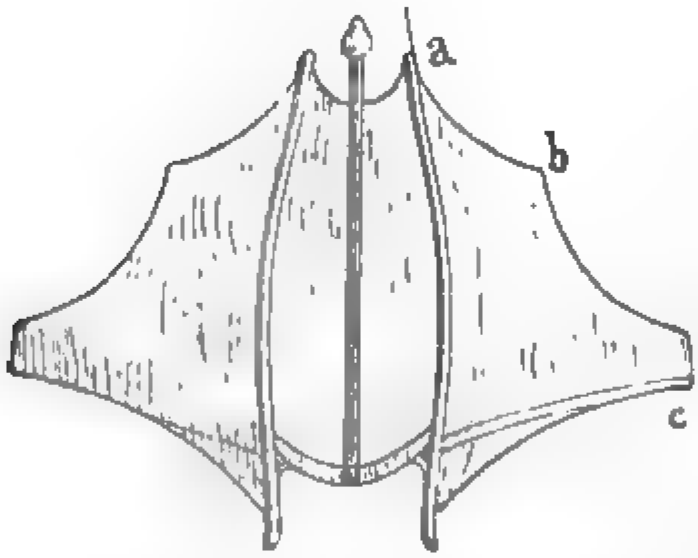

Fig. 2.—The *fulcrum* spread out, showing its lower (ventral) plate with curved margins, its distal (*a*) and subdistal (*b*) processes, its wings (*c*) which arch over its chamber and meet above, and its proximal processes (*d*). It terminates distally in a small nodule.

2. Two palps (*p* in Fig. 1, *A* and B) not jointed, but borne on a weak cross-piece of chitin. (The blow-fly has stronger supporting bars, and palps longer and more slender.)

3. A transparent funnel-shaped sheath widening towards the head, surrounds the basal division. This membrane consists of chitin, but is quite soft and movable, like the membrane of the tracheæ or the web of the wings of insects. It is directly continuous with the walls of the head, and it extends forward to enclose the whole proboscis and to form the walls of the lips. It is open above so as to allow free motion to some of the hard parts.

The mid segment folds on the basal segment by an elbow joint. On the under side of the mid segment is the *mentum*, or chin piece (*m* in Fig. 1 *A*), truncated behind, narrowing and bifurcated in front, not articulated to any hard supporting part, but fixed in the membraneous sheath which holds it in its place.

Uppermost in the mid segment is the *operculum* of Lowne (*o* in Fig. 1 *A*, *B* and Fig. 3). This is a semi-tube, slit beneath, pointed in front, and sending backwards two long processes which I shall call "the great tendons."

[1] "The Anatomy and Physiology of the Blow-fly," by B. T. Lowne, Lond. 1870.

In the central axis of the mid segment, and closely articulated to the front processes of the fulcrum, is a plate (Fig. 3, *x*) longitudinally curved upwards so as to embrace the operculum, and with it to form a canal. Its central axis and its lateral parts are thickened. Lowne calls it the cannula. It may be convenient to refer to its lateral arcuate thickenings as the *trabeculoid arches.*

Lying in the channel formed by the operculum and cannula, and firmly articulated behind with the front end of the fulcrum, is the lingua, or hypopharynx (Fig. 3, *l*). This is rather short in the house-fly, but is long in Stomoxys, serving as a piercing organ.

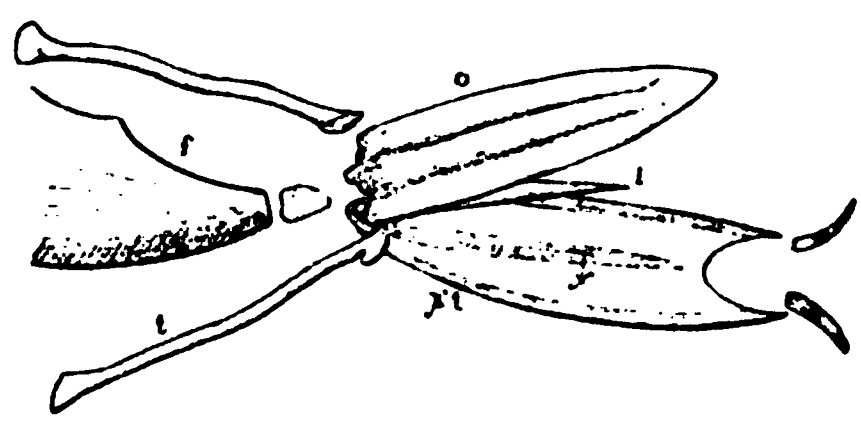

FIG. 3.—Arrangement of hard parts of mid segment (mentum not here shown). *o*, operculum, sending back the great tendons, *t*; *x*, the axis piece or cannula; *xt*, trabeculoid arches; *l*, lingua, or hypopharynx; *f*, the fulcrum (part of it). In front of the trabeculoid arches are seen the beginnings of the circum-oral rods.

The opercular piece and the hypopharynx habitually lie on the axis piece, whose edges overlap it, but they may be started up so as to project clear above the sheathing membrane of the mid segment without any rupture of the membrane.

The distal segment, or tip, called "knob" in Burmeister's Entomology (Fig. 1, *A* and *B*, *l*), is a singular scraping and suctorial apparatus, with the oral opening in its upper part set amidst the large protrusible lips. When spread out its surface is covered by a system of about eighteen pairs of curved transverse ridges. These have a general resemblance to tracheæ. Suffolk[1] calls them pseudo-tracheæ, that is, false tracheæ. They are split tubes, having a rent along their anterior surface, and are supported by a framework of chitinous semi-tubes, which are forked at alternate ends (Fig. 1, *D*, shows the relation of two of these false tracheæ with the intervening membranous crenulations). The line of opening of these tubes is zigzag, caused by the sheath-membrane flapping over the forked terminations of their supporting semi-tubes.[2] This line of opening can be shut so as to produce a closed channel, or opened and made rough like the face of a file.

[1] "On the Proboscis of the Blow-fly," by W. T. Suffolk, in Monthly Microscopical Journal, June, 1869.

[2] Well described and figured by G. Hurst in Quarterly Journal of Microscopical Science, 1856, p. 238. Fig. 1, D.

On both sides of the mouth are hard beams of chitin, supported on the trabeculoid processes of the axis piece of the mid segment (Fig. 3, *xt*), and themselves affording a foundation for the false tracheæ. We shall call them the circum-oral rods (Fig. 1, *F*). On the circum-oral rods, and intervening between the roots of the false tracheæ, is formed a set of teeth. The blow-fly has three rows of these teeth (thirty teeth in all), each tooth being two-cusped. A small house-fly (similar to *M. domestica*) has a similar arrangement, as has *Musca cæsar*. The carnivorous house-fly has only one row of five or six teeth on each side of the mouth, but the teeth are three-cusped, the cusps being more or less cut (Fig. 1, *E* and *F*). The blow-fly has been found to use its teeth for scraping sugar-candy.

I would suggest that these distinctions in the structure, number and arrangement of the teeth are of generic value, and that the name *Musca* be applied only to those species having a single row of three-cusped teeth; whilst *Calliphora*, already made to include the blow-fly, should take in those having several rows of two-cusped teeth.

On the distal end of the mentum of the mid segment, are two elastic chitinous bands, clasping the tip from behind. When these bands are pulled apart by muscles inserted in the mentum, they open the lips wide. Muscles and tracheæ are variously distributed throughout the proboscis. At base of the tip is a nervous ganglionic mass which sends fine filaments to small terminal ganglia at the lower extremity of the lips, two of these ganglia being borne on the dichotomous branches of each nerve-pedicel. The surface of the proboscis supports hairs at various parts, especially on the palps and at the tip. The tip itself has no muscles; it is tumid but not fleshy.

The proboscis of the blow-fly and other Muscidæ corresponds, except in detail, with that of the house-fly. The proboscis of the piercing-fly (*Stomoxys calcitrans*) has not the swollen tip, and its sheath is converted into a brown annulated tube, split above. Its basal part is retractile and exactly as in the house-fly. Its opercular piece, hypopharynx and axis piece are much elongated, as a piercing rather than a merely suctorial apparatus. In many points the oral apparatus of the mosquito corresponds so closely with that of the Muscidæ, as to render valuable help towards the interpretation of the latter.

Functions.—1. The proboscis is an organ of suction. The œsophagus traverses the inferior central part of the fulcrum, thence passes through the mid segment in the canal made by the operculum and the axis piece, being here joined by a pair of salivary ducts; it then opens at the mouth, communicating with the false tracheæ. It can exude a drop of clear fluid from the salivary ducts, and when the proboscis is distended it can act as an organ of suction, receiving fluids from the false tracheæ and conveying them to the digestive organs. The large supply of muscles within the fulcrum and in the axis piece, appears to be subservient to this process.

2. Retraction. — Two long and powerful retractile muscles extend from the back part of the skull (near the foramen magnum) to the proximal end of the mentum (Fig. 1, *A*, *m*). By contracting, these draw in the mid segment, so that its proximal end is close to the neck of the fly. Other muscles attached to the ventral proximal processes of the fulcrum assist in drawing it in and up, thus turning the fulcrum upon its upper proximal processes which are hinged to the frontal piece of the skull. Thus the two proximal segments of the proboscis are folded on each other, and are both drawn inwards and upwards into the skull, so that they are like the letter V lying on its side, with its acute angle backwards. One arm of this V is hinged to the lintel of the door-way, whilst the other arm bears the collapsed tip of the proboscis, which now serves as a door to close the entrance. The ends of the palps then protrude from the upper part of the doorway on both sides of the proboscis tip.

3. Protrusion.—The part taken by inflation in extending the proboscis, is so obvious that it was suggested nearly a century ago by Gleichen, but the suggestion was rejected, and W. T. Suffolk[1] infers that the structure of the interior of the head was unknown to Gleichen, "as the extension of the organ is attributed to inflation, and not to muscular action."

It is easy to dispose of Mr. Suffolk's hasty criticism. Immerse the head of the fly in caustic potash, which destroys the muscles, the chitine of the membranous sheath and the tracheal tubes remaining intact, and you can still protrude the organ by slight pressure. Further, when the proboscis is pressed out and all its parts distended, pierce with a needle the swollen air sacs under the

[1] Op. cit.

tip, and at once the tip collapses upon the mentum.[1] If you tear the membrane about the base of the proboscis that part collapses. If you press the head over much, the membrane-sheath sends out bulging processes which soon burst, sending bubbles of air through the water in which you are examining it.

I have repeated these experiments so often as to be satisfied that the rich tracheal system which crowds the lower part of the cranial chamber is the chief agent in protruding the proboscis.[2]

The examination of the muscular arrangement justifies this conclusion. Muscles cannot directly protrude anything, they only pull. In the fly they may and do aid in protruding the proboscis by swinging out the fulcrum. The long muscles which retract the mentum aid in straightening the proboscis when it is protruded, but the mentum is not attached proximally to any hard structure, and its firmness and power of supporting the tip depends on the tense condition of the membrane in which it lies, and this tenseness is due to inflation.

The great tendons which run back from the opercular piece (Fig. 3, *t*) have their tips united by muscles to the distal and the sub-distal processes of the fulcrum (*f*). Lowne understands these muscles to be flexors of the mid segment upon the basal segment. Their tendency on contracting would be rather as extensors; but both suppositions are wrong. When they contract, instead of flexing the mid segment, the great tendons themselves bend, for they are too weak and too slightly articulated to the operculum to stand much pulling. Their work is of a more delicate nature. By acting alternately on the tendons, these muscles bend the tip of the fly from side to side, enabling this organ to move nimbly from place to place, as you may see it when foraging on your breakfast table. This mechanism is well developed in ***Stomoxys***, where only the basal part of the proboscis is protrusible. We have already seen that the muscles extending from the mentum to the divergent rods which embrace the tip, serve to expand the lips to their fullest width; at the same time the tips become tensely swollen by air.

[1] It occupies this position when the proboscis is withdrawn, but never so in the living fly when the proboscis is protruded. Most of the figures in books represent it in this unnatural state, probably drawn from dead specimens.

[2] I had made this discovery before I was aware that Gleichen had fallen upon it so long ago. The rejection of his views may explain why so little attention has been given to it by others.

Thus we find that the protrusion and distension of this important organ is a joint affair, the tracheal system and the muscles combining their services.[1]

Homologies.—It is strange that no previous observer seems to have been struck by the evidence of the "great tendons" of the operculum as to what is the organic base of the mouth parts. These tendons are found, so far as we have observed, throughout the Diptera; they are evidently the tendons of some of the mouth parts, marking their origin. They could not be in the mid joint of an appendage; the muscles which move the segments of any arthropod appendage on each other, are *internal;* it is only when we get to their root that we find these tendons extending into the body of the animal. Hence we conclude that the mid segment is the true base of the fly's proboscis. We may, perhaps, go further and hold that these great tendons belong to the mandibles, for they closely resemble the mandibular tendons of other orders of insects and of the lobster. This will make the operculum represent two united mandibles, probably enclosing the labrum.[2]

The palps seem to point out the maxillæ, but it is not easy to determine to which of the hard pieces they belong, as they are borne on slight indurations of the membrane. The axis piece, with its trabeculoid bars, seems to represent the maxillæ with its inner and outer processes. The hypopharynx and mentum offer no difficulty. The small piece represented in Fig. 3 in advance of the fulcrum, may belong to the maxillæ. The membrane sheath and tip with spreading lips may be regarded as the labium with its specially developed paraglossæ.

Having made out the chief mouth parts as represented by the

[1] Gegenbaur approaches this discovery in commenting on the tracheal system of insects in water. The branchial tracheæ are kept distended in water by inflation, and he thinks that the tracheal system has a "hydrostatic function," which, in some cases, may be more important than their respiratory function. It is probable that the tracheæ of insects serve more purposes than we have yet recognized.

See Prof. Packard's account of the hydrostatic functions of the larval tracheæ of Corydalis, which illustrates and confirms Gegenbaur's view. AMERICAN NATURALIST, Vol. VIII, p. 533.

[2] Huxley says (Anatomy of Invertebrated Animals, p. 427; in American edition, p. 369): "In the common house-fly the labrum, mandibles and maxillæ coalesce at their origins and constitute the base of the proboscis, which is mainly formed by the confluent second maxillæ. Its longitudinal grooved anterior face is overhung by the elongated styliform labrum." It is probable that the author was misled by endeavoring to condense the views of others in this part. Anything done by himself would scarcely be so faulty as this passage unquestionably is.

mid segment and the tip, we have still the largest structure of all (the fulcrum) to explain. It seems to be general in Diptera; even the mosquito possesses it; in other insects it is unknown. It could not be what Prof. Huxley suggests, "the labrum, mandibles and maxillæ coalescing;" at least its structure and forms in various Diptera give no evidence of such union, and how then are we to explain the mid segment with the great tendons? Mr. Lowne makes it a composite structure, the dorsal part being epistoma, and the ventral part pharyngeal, formed in the wall of the alimentary canal. This explanation will not satisfy, for the inner surface of the fulcrum has many muscles, which could not be there if it were only a chitinous lining of the œsophagus. One might as well expect to find muscles growing on the outside of a lobster as within its throat.

In searching after the homology of this piece, I soon found that I must go outside the Diptera, nor was I long searching till the secret came out. Opening the head of a katydid and of a wasp, I found in both what I wanted; the endocranium, which runs from back to front of skull, strengthening it. Long ago Burmeister informed us that the Diptera have no endocranium, but their skulls are as empty shells, easily fractured. But here we see that Burmeister was wrong; they have the endocranium in the proper position when the insect is being hatched and when its proboscis is withdrawn; but instead of having it rigidly fixed in the skull, they have it free posteriorly, hinged in the front and able to swing out so as to form a pedestal for the mouth parts which make up the proboscis.

Comparing Mr. Huxley's excellent description of the endocranium of the cockroach,[1] we find the relation of parts with the retracted proboscis of the house-fly to correspond exactly. The endocranium has axis and wings corresponding to the structure of the fulcrum (Fig. 3). Its posterior extremity close to the foramen magnum, and the œsophagus pierces it; so with the house-fly when the fulcrum is turned in. The great tendons of the mandibles are right and left of it, as we have seen them to be in the house-fly. What is true of the house-fly is, we believe, generally true of its order.

Thus we have fallen upon a modification of structure dependent on metamorphosis of function, almost as striking as that which

[1] Anat. Invert. An., p. 403-404 (348 of American edition).

exists between the suspensor of a bird's mandible and the small bones of the human ear.

I find in the lobster a structure which is probably homologous with the endocranium of insects. It is an opademe running like a bulk-head across in rear of the rostrum, consisting of a central cross bar, and on each side two free plate-like wings. Under its central bar is the frame work which supports the stalked eyes. Its hinder surface gives attachment to muscles which reach the stomach. It is described by Huxley (*Anatomy of the Invert.*, p. 274, of American edition) as the opademe of the ophthalmic samite.

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SKETCH OF PROGRESS IN MAMMALOGY IN THE UNITED STATES IN 1879.

BY DR. ELLIOTT COUES, U.S.A.

THE year past has seen very little progress in our knowledge of recent Mammalia, so far as contributions to that subject in the United States are concerned. Mr. J. A. Allen, one of the recognized leaders, has apparently been too busy with his great work on seals (now in press and about half printed) to do much else in mammals, and the present writer's labor in the same field has been confined to the "History of North American Mammals." The latter is still too far from completion to speak about; but Mr. Allen's *Pinnipedia* may be expected to appear very shortly, doubtless in 1880. Having the supervision of its publication in its passage through the press, the writer is in position to speak confidently of its merits and importance. It will make an octavo of perhaps 800 pages, illustrated with numerous wood engravings, mostly original; and will unquestionably become at once *the* work upon the subject. In thoroughness of treatment, accuracy and extent of investigation, and other requirements of masterly workmanship, it will compare with the author's celebrated memoir on the American bison.

As Prof. Leidy has done nothing during the year, either in fossil or living mammals, the field of the former has been left to Mr. Marsh and Mr. Cope, whose important contributions are noted beyond.

Certainly the most notable and perhaps the most significant paper on mammals of the past, present and, we may add, of the

future, is Mr. Cope's, "On the genera of Felidæ and Canidæ," in the Proceedings of the Philadelphia Academy, giving the author's views of their primitive types and of the successive steps through which they have passed, with detailed characters of the genera, including several new ones, and a nominal list of the species of both families. In the Felidæ, Mr. Cope recognizes altogether fourteen genera (including *Cryptoprocta*, between *Smilodon* and *Pseudœlurus*) and ninety species—which are probably too numerous in the genera Felis and Lyncus, as the author remarks. In adopting *Uncia* of Gray as a generic term, the author assumes it to be derived from *Uncus*, a hook, but is it anything more than "ounce" in Latin? *Dinictis cyclops* n. sp., is fully described, p. 176. The interest of this paper perhaps centers about *Synagodus mansuetus* and *Dysodus pravus*, two new genera and species founded upon before-supposed varieties of *Canis familiaris.* Of the *Synagodus* it is stated to be "uncertain whether any species of this genus exists in a wild state. Should such not be the case, we can only predicate the former existence of such an one as entirely different from the *Canis familiaris*, and which has given origin to the existing one." *Dysodus pravus* is the Japanese lap dog. These are regarded as "the most specialized of the *Canidæ*." In this connection the author refers to the frequently-observed reduced dentition of man, and reasons from "what is elsewhere known in zoölogy, that the same or nearly the same specific characters may be found in different genera," that different genera may be found in the same species, which becomes a different species upon the circumstance of being referred to a new genus. Two hypothetical genera of *Hominidæ* to "be at some future day added to *Homo*," are named and described in anticipation of the establishment as a generic character of certain dental peculiarities, namely: *Metanthropos* with incisors $\frac{1}{2}$, and *Epanthropos* with molars $\frac{2}{2}$. The species of these genera, left unnamed, may be provisionally designated respectively *M. incipiens* and *E. procul*, with reference to their extremely primitive state of possible accomplishment. Much might be said, doubtless, for and against the availability of names proposed for conjectural species *in futuro.* The logical extreme of the procedure might be a potential *Pseudanthropops gingivatus*, that is, an hypothetical anthropomorphic super-simian without canines; the dental formula of which would be, according to our inference and our ignorance, I. ?, C. $\frac{0}{0}$, Pm. ?, M. ?. The new spe-

cies of *Canidæ* of this paper are *Temnocyon coryphæus* and *Icticyon crassivultus*.

In the same part of these Proceedings (April–October) Mr. H. C. Chapman describes the placentation of *Macacus cynomolgus*, and an earlier one by the same author is on the anatomy of the Chimpanzee, illustrated with four plates. Mr. John A. Ryder continues from his paper of 1878 (pp. 45–80) his notes on the mechanical Genesis of tooth forms, seeking to show the modes in which the teeth of mammals are modified by movements of the jaws in mastication, through a long series of generations; reaching the conclusion "that mechanical strains and impacts had probably been the secondary causes to which the origin of the various forms of teeth might, in a large measure, be attributed." He here offers some new evidence based upon more accurate observations of the mode in which herbivorous ungulates masticate their food. In the same line of research, Mr. Cope has a paper on the origin of the specialized teeth of the Carnivora, in the NATURALIST for March, 1879, p. 171.

Other articles on recent Mammalia by the same author in the same journal, are on the California gray whale, p. 655; on the Japanese lap dog, p. 655, and a paper on the zoölogy of Montana, p. 433. Various other brief articles or notes on mammals in the NATURALIST need not be more than alluded to here.

The Bulletin of the United States Geological Survey contains two important papers, by Mr. Allen, on the genera *Nasua* and *Bassaris*, in which the specific characters and very complicated synonymy of the two species of each genus which the author allows to stand, are carefully worked out.

For the rest, several of the newspapers of semi-scientific character give a fair space to game mammals, as they do to birds; *Forest and Stream* and the *Chicago Field* are to be specially mentioned in this connection. Among other subjects the question of hydrophobia from the bite of the skunk has occupied a prominent place; the contributions, however, being mostly the experiences of unscientific observers. It seems to be established: (1.) That skunk bite may produce a fatal disease undistinguishable from *rabies canina*, or ordinary hydrophobia; (2.) that skunk bite may be perfectly innocuous, and therefore, (3.) that hydrophobia from skunk bite only results under a rabid condition of the animal. No peculiarities of the case, as distinguished from that of a mad

dog or cat, appear to have been established, notwithstanding repeated assertions that skunk bite is always and necessarily fatal.

To the elucidation of fossil mammals the contributions of Mr. Marsh and Mr. Cope have been both numerous and important. If these still continue, as in former years, to represent the accumulation of material in the way of new genera and species, and the general enlargement of the view, rather than the attainment of final results based upon all the data acquired, they nevertheless include important discoveries and generalizations.

Foremost among these comes Mr Marsh's discovery of Jurassic mammals in this country. The original announcement was made by Mr. Marsh in June, 1878, in the *American Journal of Science*, with description of *Dryolestes priscus* from the Atlantosauris beds of the Upper Jurassic, the associated fossils being mainly Dinosaurians.

To this succeeded, in July, 1879, the notice of *Stylacodon gracilis*, and in September, 1879, additional remains of Jurassic mammals were described as *Dryolestes vorax* and *Tinodon bellus*. It is interesting to observe, first, that the Jurassic genera indicate as many new families, and further, that they confirm Mr. Marsh's original determination of the Atlantosaurus beds as Upper Jurassic.

The same journal for June has also an interesting paper by the same on polydactyle horses, recent and extinct. It is illustrated with a plate of the genealogy of the horse, showing the modification of the limbs and teeth from *Orohippus* to *Equus*. This paper defines clearly, for the first time it is believed, the true difference between the orders none too aptly named Perissodactyla and Artiodactyla by Owen. The difference between the "odd-toed" and "even-toed" structure is stated to be "a profound one, extending to nearly every part of the skeleton, and marking two distinct groups of Ungulates. The number of toes has really nothing to do with the true distinction, and hence the terms in use are especially misleading. The real difference, so far as the feet are concerned, is, that in the Perissodactyle type the axis of the limb passes through the middle of the third digit *(Mesaxonia)*, while in Artiodactyles it is outside of this digit *(Paraxonia)*, between it and the fourth."

Mr. Cope's contributions to the same branch of the subject during 1879, will all be found in the publications of the Philadel-

phia Academy, of the American Philosophical Society, the AMERICAN NATURALIST, and the U. S. Geological Survey "Bulletin." The first of these has been already noted in connection with recent mammals. The NATURALIST contains many short papers, among which are: Extinct Mammalia of Oregon, p. 131 (in full in Bull. U. S. Geological Survey, No. 1, Feb. 28, p. 55–69); *Merycopater* and *Hoplophoneus*, p. 197; a new Anchitherium *(A. præstans)*; A Decade of Dogs (five genera, ten species) p. 530; and the Cave Bear of California *(Arctotherium simum* sp. n.), p. 791.

Mr. J. A. Ryder, in the NATURALIST for September, notes a remarkable genus of sloths, *Grypotherium* Reinhardt, typical of a sub-family *Diarhinæ* and a species of *Cœlodon* Reinhardt, 1878.

Mr. Cope's paper, above mentioned, in the Hayden Bulletin, describes for the Miocene Territories of Oregon: *Enhydrocyon* (g. n.) *stenocephalus*, *E. basilatus*, *Poëbrotherium sternbergii*, *Boöchœrus* (g. n.) *humerosus*, *Lutrictis lycopotamicus*, *Protolabis transmontanus*, spp. nn.

The same author's "Relations of the Horizons of Extinct Vertebrata of Europe and North America," in the same Bulletin, pp. 33–54, is doubtless his most important contribution, but it is one to which it is impossible to do justice in the present connection. His conclusions are:

"I. Portions of all the faunæ of all the primary divisions of geologic times have been recognized on both the European and North American continents.

"II. Parallels requiring general identification of principal divisions of these fauna may be detected. These are: the Coal measures; the Permian; the Laramie; the Mæstrichtian; the Eocene; the Miocene.

"III. Exact identifications of restricted divisions may be made in a few instances only; such are the Turonian and the Niobrara; the Suessonian and the Wasatch; the *Equus* beds and the Pliocene."

The Bulletin of the U. S. Geological Survey, Vol. v., No. 2, published September 6, 1819, has a paper by Mr. Cope, on the extinct *Rhinoceridæ* of North America and their allies, which goes very fully into the characters of the group, giving new definitions of Perissodactyle families and genera, and describing many of the latter in detail, with analyses of various species.

The same paper is adapted to the AMERICAN NATURALIST for December, 1879, pp. 771*a–j*, with eight cuts.

Pages 798*a–b*, of AMERICAN NATURALIST for December, give in brief some of the more important results of Mr. Cope's recent trip to the Pacific coast, describing among other things the remarkable new fossil cats, *Archælurus debilis* and *Hoplophoneus platycopis.*

Mr. Cope's Palæontological Bulletin, No. 31, being a "Second Contribution to a Knowledge of the Miocene Fauna of Oregon," "read before the American Philosophical Society, December 5, 1879," contains descriptions of the following new fossil mammals: *Hesperomys nematodon*, *Sciurus vortmani*, *Canis lemur*, *Chænohyus* (g. n.) *decedens*, *Thinohyus trichænus*, *Palæochærus subæquns*, *Coloreodon* (g. n.) *ferox*, *C. macrocephalus.* The date of printing is given as December 24, 1879.

——:o:——

A REVIEW OF THE MODERN DOCTRINE OF EVOLUTION.[1]

BY E. D. COPE.

THE doctrine of evolution of organic types is sometimes appropriately called the doctrine of derivation, and its supporters, derivatists. This is because it teaches the derivation of species, genera and other divisions, from pre-existent ones, by a process of modification in ordinary descent by reproduction. The opposite or creativist doctrine teaches that these forms were created as we see them to-day, or nearly so; and that the natural divisions and species of organic beings have never been capable of change, the one into the other.

I. The Evidence for Evolution.

The reasons which induce me to accept the derivatist doctrine, and to reject the creational, fall under the two heads of probabilities and conclusive evidence. The probabilities are cumulative in their pointings, and form part of a total body of evidence which is, to my mind, conclusive. The reasons why derivation is probable are the successional relation of increment or decrement of structure, observed in:

[1] Abstract of a lecture delivered before the California Academy of Sciences, Oct. 27, 1879.

1. Systematic relation (taxonomy); 2. Embryonic growth (embryology); 3. In geologic time (palæontology); 4. And in the coincidence in the successions seen in Nos. 1, 2 and 3.

The fact that it is necessary to arrange animals in an order corresponding with the phases of their embryonic history is remarkable; but the further fact, shown by palæontology, that the same succession marked the ages of past time, at once brings evolution within the limits of strong probability. Nevertheless, all this might have been a mere system, without transitions between its members; organic types might have been created unchangeable, but presenting the mutual relations in question. But if transitions among these members can be shown to take place, then indeed the phenomena mentioned receive a sufficient explanation. They are seen to be the necessary relations of the parts of a shifting scene of progression and retrogression; they express combinations of structure, which, though often long enduring, are, nevertheless, not perpetual, but give way to other combinations to be in their turn dissolved. Now, if there is anything well known in nature, it is that there are divisions of various ranks in the vegetable and animal kingdoms, whose contents present variations of structure which are confessedly additions to or subtractions from the characters of ancestors, which have appeared during ordinary descent. The protean species, genera, etc., are well known to biologists, and every naturalist who admits varieties, sub-species, sub-genera, etc., admits derivation so far as they are concerned. The facts of variation, including "sporting," etc., are notorious, not only among domesticated, but also in wild animals and plants. The facts have led some persons to suggest that species have been produced by evolution from a single specific center, but that the genus and other comprehensive divisions are unchangeable. But I think I have shown, in a paper entitled, "The Origin of Genera,"[1] that the structural characters which define genera, and even higher divisions, are subjects of variation to as great an extent as are the less profound specific characters; and, moreover, that the evidence of derivation which they present is singularly clear and conclusive. The changes of both genus and species character are always of the nature of additions to or subtractions from those of one generation displayed by their descendants. As such, they form the closing chapters of the embryonic or growth-history of the modified generation.

[1] Philadelphia, 1869. "Proceedings Academy Natural Sciences, 1868."

In order to explain more fully the application of the above statements, I introduce a few examples selected from the subjects of my studies. Their number might be indefinitely extended. I first cite the genera of the tailless *Batrachia Anura* (frogs, toads, etc.), whose relations are very simple and clear, and show the parallelism between adult structure and embryonic succession. See above, 1 and 2.

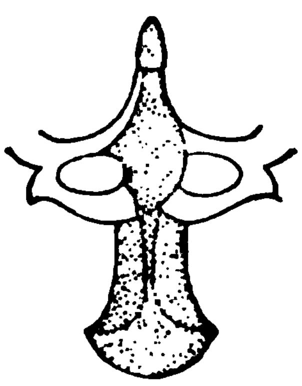

FIG. 1.

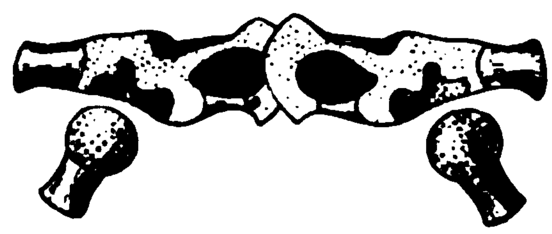

FIG. 2.

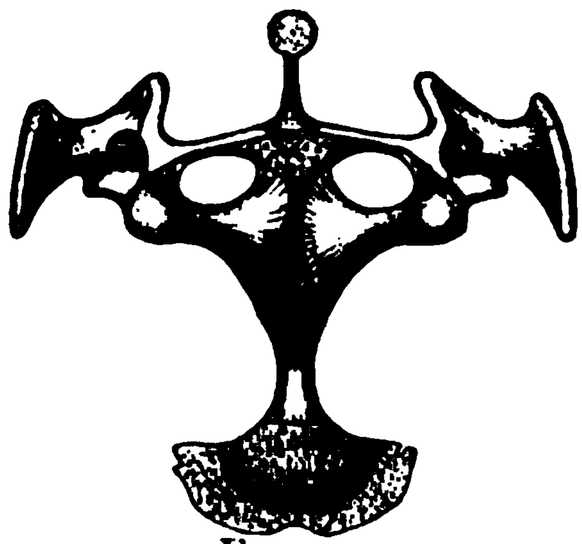

FIG. 3.

Shoulder girdles of *Anura*. Fig. 1, of the Arciferous type (*Scaphiopus holbrooki*). Fig. 2, *Rana temporaria*, tadpole with budding limbs. Fig. 3, do. adult. Figs. 2 and 3 from Parker.

The greater number of *Batrachia Anura* fall into two divisions, which differ only in the structure of the lower portion of their scapular arch, or shoulder girdle. In the one the opposite halves are capable of movements which contract or expand the capacity of the thorax: in the other the opposite halves abut against each other so as to be incapable of movement, thus preserving the size of the thoracic cavity. But during the early stages, the frogs of this division have the movable shoulder girdle which characterizes those of the other division, the consolidation contituting a modification superadded in attaining maturity. Furthermore, young *Anura* are toothless, and one section of the species with embryonic shoulder girdle never acquire teeth. So here we have a group which is imperfect in two points instead of one. This is the tribe *Bufoniformia;* the tribe with teeth and embryonic shoulder girdle is called the *Arcifera*, and that which is advanced in both these respects is the *Raniformia.* Now the frogs of each of these divisions present nearly similar scales of development of another part of the skeleton, viz: the bones of the top of the skull. We find some in which one of these bones (ethmoid) is represented by cartilage only, and the fronto-parietals and nasals are represented by only a narrow strip of bone each. In the next type the ethmoid is ossified; in the next, we have the fronto-parietal completely ossified, and the nasals range from nar-

row strips to complete roofs; in the fourth station on the line, these bones are rough, with a hyperostosis of their surfaces; and in the next set of species, this ossification fills the skin, which is thus no longer separable from the cranial bones; in the sixth form the ossification is extended so as to roof in the temporal muscles and enclose the orbits behind, while in the rare seventh and last stage, the tympanum is also enclosed behind by bone. Now all of these types are not found in all of the families of the *Anura*, but the greater number of them are. Six principal families, four of which belong to the *Arcifera*, are named in the diagram below, and three or four others might have been added. I do not give the names of the genera which are defined as above described, referring to the explanation of the cuts for them, but indicate them by the numbers on the left margin of the page, which correspond to those of the definitions above given. A zero mark signifies the absence or non-discovery of a generic type.

	Sternum embryonic.				Sternum complete.
	Bufoniformia.	Arcifera.			Raniformia.
	Bufonidæ.	Scaphiopidæ and Pelobatidæ.	Cystignathidæ.	Hylidæ.	Ranidæ.
1—.	0	0	1	1	0
2—	2	2	2	2	0
3—	3	0	3	3	3
4—	4	4	4	4	4
5—	5	5	0	5	5
6—	6	6	6	6	0
7—	7	0	0	0	0

It is evident, from what has preceded, that a perfecting of the shoulder-girdle in any of the species of the Bufoniform and Arciferous columns, would place it in the series of *Raniformia*. An accession of teeth in a species of the division *Bufoniformia*, would make it one of the *Arcifera*; while a small amount of change in the ossification of the bones of the skull would transfer a species from one to another of the generic stations represented by the numbers of the columns from one to seven.

There are few groups where this law of parallelism is so readily observed among cotemporary types as the *Batrachia*, but it is none the less universal. The kind of parallelism usually observed is that in which there is only a partial resemblance between adults of certain animals and the young of others. This has been termed

FIG. 2.

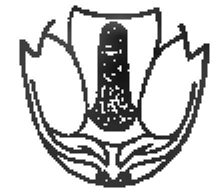

FIG. 2.

FIG. 3[3].

FIG. 3, wanting.

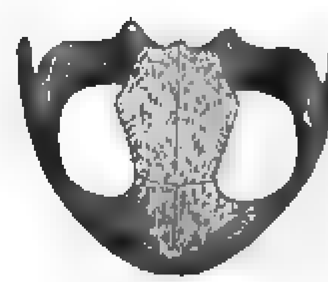

FIG. 5.

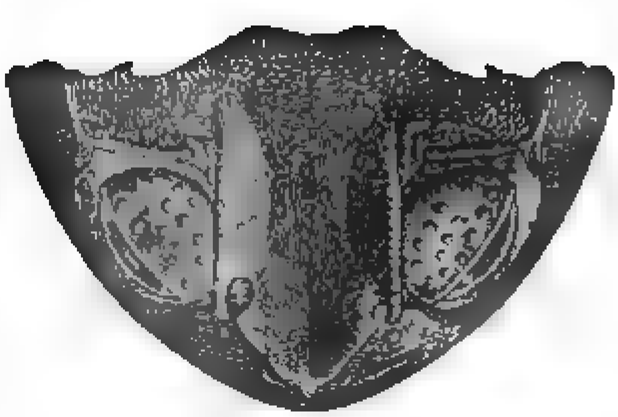

FIG. 6.

FIG. 6.

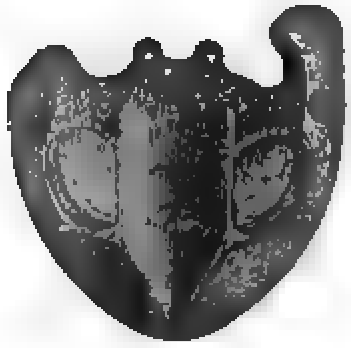

FIG. 7.

FIG. 7, wanting.

BUFONIDÆ.

SCAPHIOPIDÆ AND *PELOBATIDÆ.*

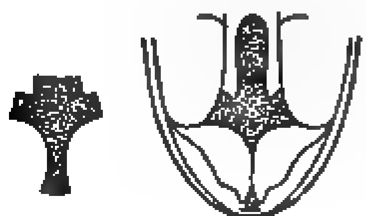

Fig. 1.

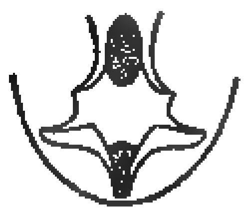

Fig. 2.

Fig. 2^1.

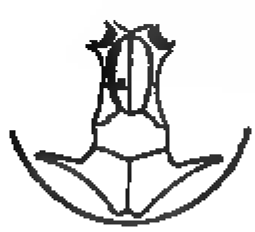

Fig. 3^3.

Fig. 6.

HYLIDÆ.

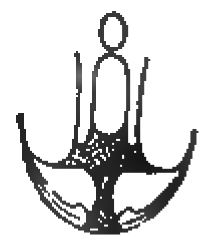

Fig. 1.

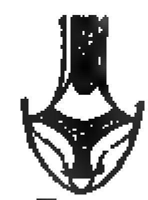

Fig. 2.

Fig. 3.

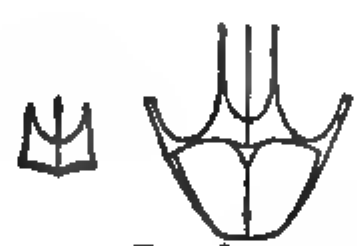

Fig. 3^2.

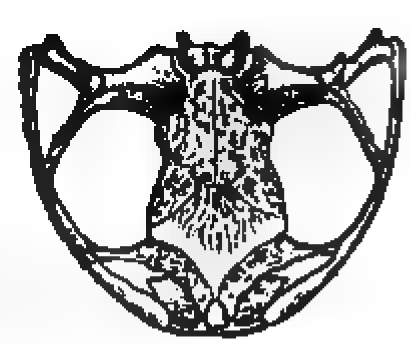

Fig. 4.

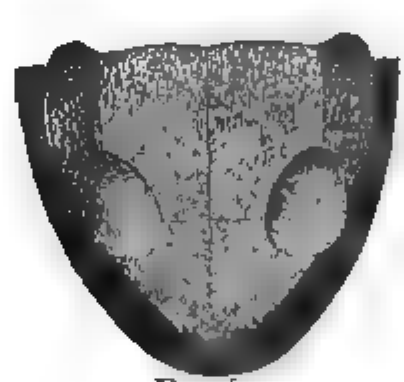

Fig. 6.

CYSTIGNATHIDÆ.

"inexact parallelism," and the relation is presented by forms not very nearly phylogenetically related. The more remote the phylogenetic lines of two types, the more "inexact" will their parallelism be. It was once a question whether any parallelism can be traced between the members of the five or six primary divisions of animals, and in my essay on the "Origin of Genera," I was compelled to state that there was then "no evidence of the community of origin of these divisions." Since that time, Haeckel has published his "Gastræa Theory." This is a grand generalization from the facts of embryology, which shows the community in type of the early stages of all animals, and the similarity of the phases which they present during a part of their larval life. The exceptions to this law which have been observed, will probably be explained, as have been those which have been urged against the law of homologies in anatomy.


FIG. 3_{-1}.


FIG. 3.

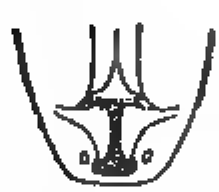
FIG. 3^{1}.

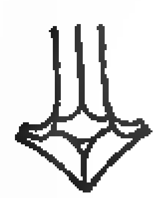
FIG. 3^{2}.

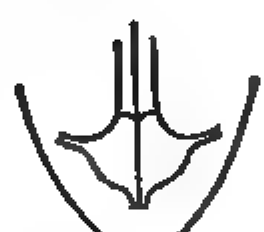
FIG. 3^{3}.

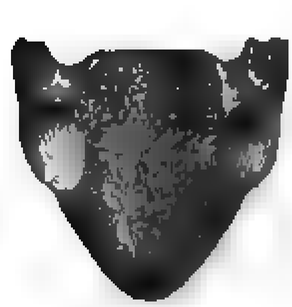
FIG. 5.
RANIDÆ.

The palæontology of the *Batrachia Anura* is largely unknown, so we must look elsewhere for proof of the truth of the fourth proposition, viz., that the successional relation in embryology corresponds with that shown by palæontology to have existed in geologic time.

For this purpose I select one of the most complete series known to palæontology; that of the camels or *Camelidæ*, whose remains are found abundantly in various parts of our country. The succession of the known genera is seen in the structure of the bones of the feet, and of the superior incisor and premolar teeth. The metatarsal and metacarpal bones are or are not coössified into a cannon bone; the first and second superior incisor teeth are present, rudimental or wanting, and the premolars number from four to one. The relations

which these conditions bear to geologic time is displayed in the following table, commencing with the lowest horizon :

	No cannon bone.	Cannon bone present.				
	Incisor teeth present.		Incisors one and two wanting.			
	4 premol'rs.			3 prem'rs.	2 prem's.	1 prem'r.
Lower Miocene.	*Poëbrotherium.*					
Upper Miocene.		*Protolabis.*	*Procamelus.*	*Pliauchenia.*		
Pliocene and Recent.					*Camelus.*	*Auchenia.*

This table shows that geological time has witnessed, in the history of the *Camelidæ*, the consolidation of the bones of the feet and a great reduction in the numbers of the incisor and premolar teeth. The embryonic history of these parts is as follows: In the fœtal state all the *Ruminantia* (to which the camels belong) have the cannon bones divided as in *Poëbrotherium ;* they exhibit also incisor teeth, as in that genus and *Protolabis.* Very young recent camels have the additional premolar of *Pliauchenia.* They shed this tooth at an early period, but very rarely a camel is found in which the tooth persists. The anterior premolar of the normal *Camelus* is in like manner found in the young lama (*Auchenia*), but is shed long before the animal attains maturity. I may add that in some species of *Procamelus* caducous scales of enamel and dentine in shallow cavities represent the incisive dentition of *Protolabis.*

It remains to shows that characters of the kind above mentioned are sometimes inconstant; that they may or may not appear in individuals of a species. Under such circumstances it is evident that their origin does not imply any break in the line of descent.

First, as to a family character. It is well known that the deer differ from the giraffes in the presence of a burr or ring of osseous excressences surrounding the base of the horn. Now in the extinct tertiary genus *Cosoryx* there are three species which possess or lack this burr indifferently. Why some individuals should, and others should not possess it, is not known.

Second, as to a generic character. The genus *Canis* (dog) is defined by the presence of two tubercular molars in the inferior series. The allied genus *Thous*, possesses three such teeth, while

Icticyon has but one. Now examples of *Canis familiaris* (domestic dog) with but one tubercular molar are not rare, while an individual with three is occasionably found.

To take another case. The normal dentition of *Homo* (man) is, on each side, incisors, 2; canine, 1; premolars, 2; molars, 3. It is very common to find in the higher races, individuals who have molars only two in one or both jaws; and the absence of the external incisors of the upper jaw is almost as frequently met with. Here we have two new generic variations in one and the same species.

In specific characters variations are most familiar. Thus, the young of deer are generally spotted, and the adults are nearly uniform in coloration. Some deer (as the *Axis*) retain the spotted coloration throughout life, while an occasional spotted individual of unicolor species, is a violation of specific character by a failure to develop. The larvæ of some salamanders are of uniform coloration, and the adults spotted. The unicolor adults of the same species, not uncommonly met with, present examples of the same kind of variation.

Any biologist can select hundreds of similar cases from his special department of study.

II. The Laws of Evolution.

Having reviewed the reasons why the doctrine of evolution should be received as truth, I desire to give attention to the laws which may be made out by reference to its phenomena. Progress in this direction is difficult, owing to the natural impediments in the way of studying the history of the growth of living beings. We will, however, commence by examining more fully the phenomena with which we have to deal.

It is well understood that the world of animal life is a nicely adjusted equilibrium, maintained between each individual and its environment. This environment exerts forces both purely physical, and those exercised by other animals. Animals antagonize each other in procuring food, whether that food consist of vegetation or of other animals, but in the latter case the conflict is more severe. A similar competition exists among male animals in the matter of reproduction. These exhibitions of energy constitute the struggle for existence, which is the daily business of the living world. It is well understood, that in this struggle the individuals best provided with means of self-preser-

vation necessarily survive, while the weak in resources must disappear from the scene. Hence those which survive must display some especial fitness for existence under the circumstances of their environment, whatever they may be. So the "survival of the fittest" is believed to be a law of evolution, and the process by which it is brought about has been termed "natural selection." The works of Darwin and others have satisfied biologists that this is a *vera causa.*

Before the excellence of a machine can be tested, it must exist, and before man or nature selects the best, there must be at least two to choose from as alternatives. Furthermore it is exceedingly improbable that the nicely adapted machinery of animals should have come into existence without the operation of causes leading directly to that end. The doctrines of "selection" and "survival" plainly do not reach the kernel of evolution, which is, as I have long since pointed out, the question of "the origin of the fittest." The omission of this problem from the discussion of evolution, is to leave Hamlet out of the play to which he has given the name. The law by which structures originate is one thing; those by which they are restricted, directed, or destroyed, is another thing.

There are two kinds of evolution, progressive and retrogressive; or, to use expressions more free from objection, by addition of parts, and by substraction of parts. It is further evident that that animal which adds something to its structure which its parents did not possess, has grown more than they; while that which does not attain to all the characteristics of its ancestors has grown less than they. To express the change in the growth-history which constitutes the beginning of evolution, I have employed the terms "acceleration and retardation." Generally these expressions are literally exact, *i. e.*, there is an increased rate of growth in evolution by addition, and a decreased rate in evolution by subtraction; but this is not always the case, for some divisions of animals have increased the length of their growth-period without reference to evolution in structure. The terms express the phenomena figuratively, where not exact in the sense of time, and I believe they are sufficiently clear. The origin of the fittest is then a result of either acceleration or retardation. It is easy to perceive that a character which makes its appearance in a parent before or near to the breeding season is likely to be

transmitted to its descendants; so also a character which is lost near this time is likely to be wanting from the offspring. The causes of acceleration and retardation may next claim attention.

It is well known that the decomposition of the nutritive fluids within living animals gives rise, in the appropriate tissues, to exhibitions of different kinds of forces. These are, motion in all classes; heat in some only; in a still smaller number, electricity and light; in all, at certain times, growth-force or bathmism; in many, phrenism or mental or thought-force. These are all derived from equivalent amounts of chemical force which are liberated by the dissolution of protoplasm. This organic substance, consisting of CHON, undergoes retrograde metamorphosis, being resolved into the simpler CO_2, HO, etc., and necessarily liberates force in the process. None of the functions of animal life can be maintained without supplies of protoplasm. We have here to do with bathmism. It consists of the movement of material to, and its deposition in, certain definite portions of the growing egg, or fœtus, as the case may be. It is different in its movements in every species, and its direction is probably the resultant of a number of opposing strains. In the simplest animals its polar equilibrium is little disturbed, for these creatures consist of nearly globular masses of cells. As we ascend the scale a greater and more marked interference becomes apparent; radiated animals display energy in a number of radiating lines rather than in the spaces between them; and in longitudinal animals, a longitudinal axis exceeds all others in extent and importance. In the highest animals its results are much more evident at one extremity of the axis (head) than at the other, and the diverging lines are reduced to four (the limbs). In each species the movements of this force are uniform and habitual, and it is evident that the habit is so deeply seated that only a very strong dynamic interference can modify or divert it. The interfering forces are probably all those transmissible through living tissue, and especially molar force. Thus every species has its own specific kind of bathmic force.

The characters of living beings are either adaptive or non-adaptive; they are either machines especially fitted to meet the peculiarities of their environment, or they are not. Among the latter may be ranged rudimental structures and also many others

of no sufficient use. They are all due either to excess or defect of growth force; they are either consequences of a removal of nutritive material to other portions of the body; or they are due to an excess of such material which renders an organ or part useless through disproportionate size. Of the former class may be cited the absence of the tail in some monkeys and birds; also of the teeth in some Cetaceans; of the latter kind are the enormous tusks of the mammoth and the recurved superior canines of the babyrussa. The change of destination of this material has been probably due to the construction of adaptive machines whose perfection from time to time has required the use of larger and larger proportions of force and material.

In considering the origin of adaptive structures, two alternative propositions are presented to us. Did the occasion for its use follow the appearance of the structure, or did the need for the structure precede its appearance? The following answer to the question has always been the most intelligible to me. Animals and plants are dependent for existence on their environment. It is an every-day experience that changes in environment occur without any preparation for them on the part of living things. If the changes are very great, death is the result. It is evident that the influence of environment is brought to bear on life as it is, or has been, and that special adaptations to it on their part must follow, not precede changes of climate, topography, population, etc. We have another important consideration to add to this one, viz: the well-known influence of use, *i. e.*, motion, on nutrition. Exercise of an organ determines nutritive material to it, and the nervous or other influence which does this, equally determines nutritive material to localities in the body to which an effort to move is directed, whether an executive organ exist there or not. The habit of effort or use determining the nutritive habit must be inherited, and result in the growing young, in additional structure. Change of structure, denied to the adult on account of its fixity, will be realized in the growing or plastic condition of fœtal or infant life. The two considerations here brought forward lead me to think that the cause of acceleration, in many adaptive structures, is environment alone, or environment producing movements, which in turn modify structure. The character of the stimulus in the successive grades of life may be expressed by the following table, passing from the lowest to the highest:

1. Passive or motionless beings;
   by climate and food only.
2. Movable beings;
   by climate, food and motion.

   By motion either;

   a, unconscious, or[1]

   aa, conscious, which is,

   b, reflex, or

   bb, directed by desire without ratiocination, or

   bbb, by desire directed by reason.

The only general rules as to the direct influence of motion on structure which can be laid down at present are two, viz: That density of tissue is in direct ratio to pressure, up to a certain point;[2] and that excess of growth force, in a limited space, produces complications of the surfaces stimulated.[3] These and other laws, yet unknown, have probably led the changes expressed by evolution, while many others have followed the disturbance of equilibrium which they have produced.

I here allude incidentally to the question of transmission or inheritance. It has been maintained above that the bathmic force of each species is different from that of all other species. This force is characteristic of some unit of organization of living beings; and this probably consists of several molecules. This unit has been termed, by Haeckel, the plastidule. The transmission of the bathmic force of one generation to another would be effected by the transmission of one or more living plastidules; and this is probably precisely what is accomplished in reproduction. The *Dynamic Theory* of reproduction I proposed in 1871,[4] and it has been since adopted by Haeckel under the name of perigenesis. I compared the transmission of bathmic force to that of the phenomenon of combustion, which is a force conversion transmitted from substance to substance by contact. The recent observations of Hertwig, Bütschli and others, confirm this view. The theory of pangenesis, devised to explain the phenomenon of reproduction, is to my mind quite inadequate.

[1] Movements coming under this head are often called reflex.

[2] See *Penn Monthly*, 1872.

[3] "Method of Creation," Philadelphia, 1871.

[4] "Method of Creation," 1871.

EXPLANATION OF CUTS OF CRANIA OF ANURA.

The numbers in each column correspond with the types of ossification mentioned in the text, and are the same as those in the table of families given in the same connection. The power numbers attached to Fig. 3, represent the degree of ossification of the nasal bones, except the —1, which signifies unossified ethmoid. Most of the cuts are original.

BUFONIDÆ.—Fig. 2, anterior part of skull of *Chelydobatrachus gouldi* Gray, from Australia. Fig. 3, do of *Schismaderma carens* Smith, S. Africa. Fig. 6, top of head of *Peltaphryne peltacephala* D. and B., Cuba. Fig. 7, top of head of *Otaspis empusa* Cope, Cuba.

SCAPHIOPIDÆ AND PELOBATIDÆ.—Fig. 2, diagram of top of cranium of *Didocus calcaratus* Micahelles, Spain. Fig. 5, skull of *Scaphiopus holbrooki* Harl., United States. Fig. 6, skull of *Cultripes provincialis*, from France, after Dugès.

HYLIDÆ.—Fig. 1, *Thoropa misiessi* Bibr., Brazil. Fig, 2, *Hypsiboas doumerci* D. and B., Surinam. Fig. 2^1, *Hypsiboas punctatus* Schn., Brazil. Fig. 3^2, *Scytopis venulosus* Daudin, Brazil. Fig. 6, *Trachycephalus geographicus* D. and B., Brazil, after Steindachner.

CYSTIGNATHIDÆ.—Fig. 1, *Eusophus nebulosus* Gir., Chili. Fig. 2, *Borborocates tasmaniensis* Gthr., Tasmania. Fig. 3, *Elosia nasus* Licht., Brazil. Fig. 3^3, *Hylodes oxyrhynchus* D. and B., W. Indies. Fig. 4, *Grypiscus umbrinus* Cope, Brazil. Fig. 6, *Calyptocephalus gayi* D. & B., Chili.

RANIDÆ.—Fig. 3^1, *Ranula chrysoprasina* Cope, Costa Rica. Fig. 3, *Rana oxyrhyncha* Sund., S. Africa. Fig. 3^1, *Rana clamitans* Daud., N. America. Fig. 3^2, *Rana agilis* Mus., Berol. Fig. 3^3, *Rana hexadactyla* Less., India. Fig. 4, *Polypedates quadrilineatus* D. and B., Ceylon.

[*To be Continued.*]

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CONCERNING AMBER.[1]

BY ERMINNIE A. SMITH.

THE history of amber illustrates most clearly not only the slow and tedious growth of civilization, but also the seeming perversity and obtuseness of human nature, which, especially in former times, so retarded the advancement of science. Exhuming this history from the dim, far distant, prehistoric past, we find that from being first used for fuel by the almost barbaric northern hordes, among the more refined southern peoples, amber, like bronzes and their other articles of luxury, took the place of coin and had its economical and financial import. The oldest written documents that have come to us, mention it as one of the chief articles of luxury of the ancient civilized world, an object of greater request than fine gold.

[1] Read before the "American Asso. for the Advancement of Science," at Saratoga, August, 1879.

Three thousand years ago it was well known among the inhabitants of Hellas that amber would attract light bodies, and Thales, one of the "seven wise men of Greece," adduced that circumstance in support of his theory that inanimate objects possessed souls, but two and a-half thousand years passed before it was discovered that it was this self-same power which, flashing amid the roar of thunder, illuminated the wide canopy of Heaven, bound iron to iron and directed the silently recurring course of the magnetic needle.

Tamed and chained as we have considered this all-pervading element, still, as day by day we are startled by new discoveries, and while awaiting the result of investigations which may transform the night of our great metropolis into day, are we not as puzzled that these problems should have remained so long unsolved as astonished at their solution?

Americans can complacently pardon the inexplicable fact that Dr. Wall, the English scientist, when succeeding in drawing the electric spark from amber and hearing the crackling sound accompanying it, compared the two to thunder and lightning, but left the discovery of their being identical to our Benjamin Franklin, with his kite and key.

Although nearly two thousand years ago, Pliny wrote that amber was the fossil resin of the extinct Conifer, *Succinum pinites*, to-day the subject presents many unsolved problems. It is true the modern geological column has assigned it an approximate geological place, and modern chemistry has given it a formula, and its principal scientific value as the source of succinic acid and varnish.

A brief review of some established facts in regard to amber as also some of the erroneous but popularly received ideas, which, if unimportant, still remain uncorrected, will perhaps show that for a substance ever popular, coveted as a luxury, even ranking as a gem, both useful and ornamental, with a name in every language expressive of its many qualities, it has scarcely received the attention it deserves.

Probably the oldest of these names is *bernstein*, or its equivalent in the old Teutonic, from its combustibility. Its two Latin names are *succinum* (juice) and *lincurium*. In Persian it is called *körnbu*, or straw robber; in French the trivial name is also *tire de paille*, from its attracting straw; in Italian, Spanish and English

nearly the same name is given for amber, signifying cluster or mass. The first Greek name applied to it was a term signifying the rays of the sun, either from the color or some relation to the sun god. The popular Greek name was *electron*, or the attractor, and thus our substance can boast of having added a word to nearly every language, as even the mother-tongue-loving Germans find *electrität* more euphonious than their harsher synonym, *bernsteinkräftigungrüstzeug*.

Italy, Spain, France, Switzerland and England are given as amber-producing countries, but it must not be forgotten that under this name are included many fossil resins, the differences in which have as yet been hardly determined. In Lemburg, in the Tertiary sandstone, with giant oysters, a splendid amber is found in immensely large pieces, clearer than the Prussian, and producing a most delightful odor when burnt.

In the pitch coal of Bohemia, Reutz found specimens containing sulphur, and also with the foraminifera of the Vienna Tertiary. Daubré found amber in Alsace, and Schubert in the Alps, but these were of a different quality from that of the Baltic sea. But there is no doubt that this amber conifer forest reached from Holland over the German coast, through Siberia and Kamtschatka even to North America, and from the abundance of amber found in some localities, those conifers must have been as productive as is at present the *Dammara australis* of New Zealand, the twigs and branches of which are so laden with white resin as to have the appearance of being covered with icicles.

One of the great deposits of amber is in the Hauptvaterland, where on the plains of Pomerania the peasants dig in the surface clay for it. In the vicinity of Brandenburg, pieces have been found weighing four pounds.

From this abundance of amber in the drift clay and also from the fact that branches of "arbor vitæ" *(Thuja occidentalis)* occur in the Baltic amber, and have been found in the stomach of the mastodon in the United States, Göppert concluded that the "Diluvial," or time of the mammoth in the old world and mastodon in the new, was the age of amber.

This theory has since been entirely disproved.

By far the most celebrated locality for its richness in amber, and one which still possesses great stores of this valuable fossil, is the peninsula of Samland—a portion of Prussia nearly surrounded by the Baltic sea.

The northern part of this region, which constitutes the promontory of Brüsterort, is very hilly, and the coast banks are often from one hundred and fifty to three hundred feet high. Formerly this was all owned and worked by the German government, and was watched by *gens d'armes;* all amber found, even by the peasants in ploughing, being claimed, the finder, however, receiving one-tenth of its value. For the piece in the Berlin Museum, weighing eighteen pounds, the finder received a thousand dollars.

Until ten years ago, during stormy weather, when the waves were beaten against the banks of this coast, the amber was thrown up in quantities, entangled in the seaweeds, and a hundred hands were ever ready to intercept it with their nets, a trying occupation, as the roughest storms yielded the richest booty. Of late years the diving apparatus has been used so successfully that the marine deposit has been greatly diminished, and systematic mining is now carried on inland, where the amber is much finer.

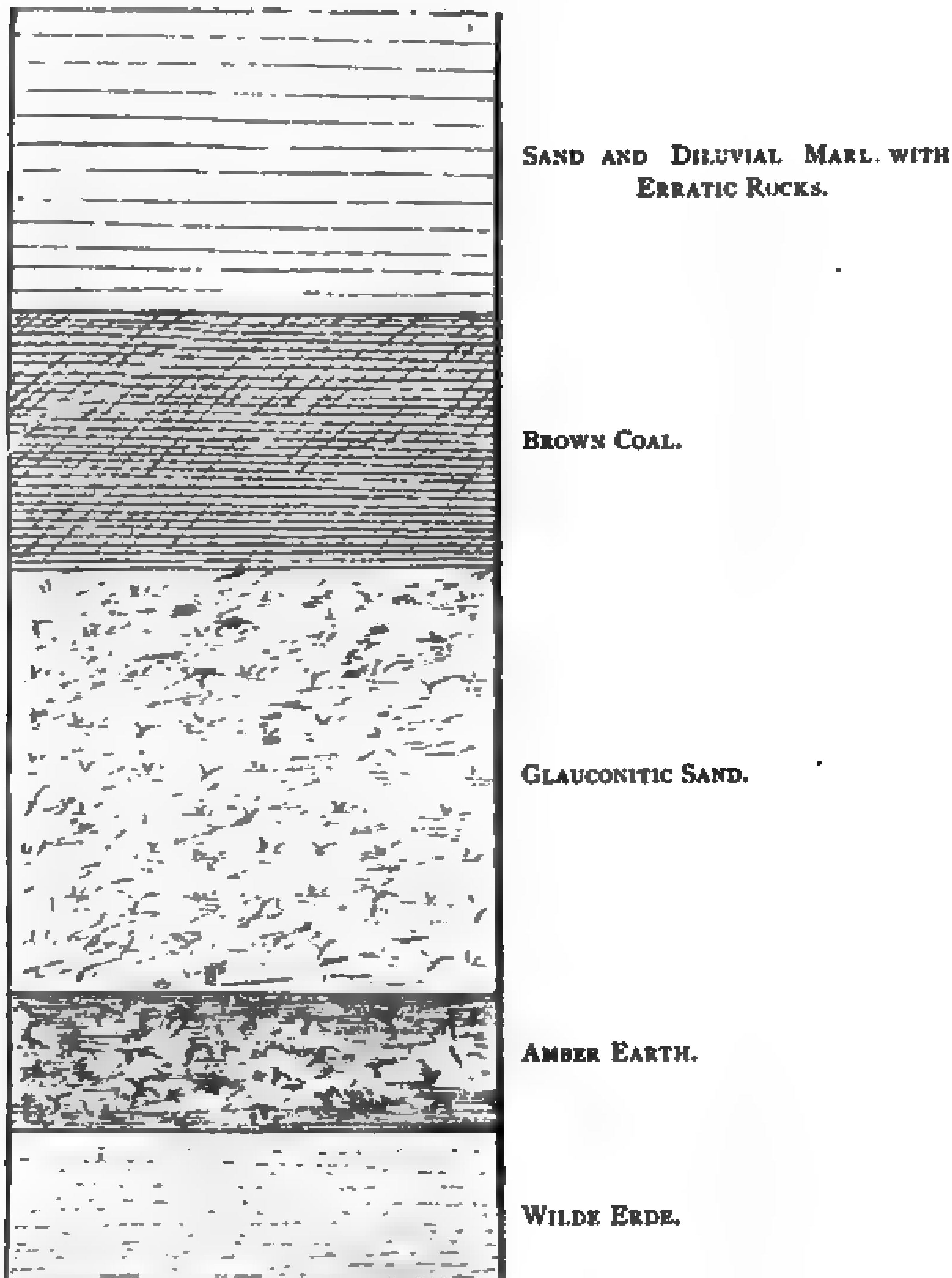
The price of amber has increased during the last year, and this advance is caused by the diminution of the yearly product, many of the pächters, or renters, having thrown up their contracts and abandoned the business of mining on that account.

It was in this famed locality of Samland, so favorable for geological survey that Prof. Zaddach of the University of Königsburg, pursued his investigations relating to the birthplace of amber, and his report throws great light upon this vexed question.

Taking a section of the cliffs where the geological structure is exposed. he finds that wherever the Tertiary formation crops out, it always comprises two different deposits. The underlying consisting of thick beds of glauconitic sand, which sometimes attains a height of sixty feet above the sea level, and upon this rest the beds of the Brown Coal formation, from sixty to a hundred feet thick. Under the green sand lies the so-called amber earth, only from four to six feet thick, and underneath this the "Wilde Erde," so called because containing no amber.

Sometimes the beds of green sand are cemented by hydrated oxyd of iron into a coarse sandstone which often contains well-preserved fossils representing the Tertiary period, but as this glauconitic sand is a marine formation, it follows that the amber it contains does not lie in its original bed—that is, not in the soil of the old forest in which the amber pines grew—but that the amber was washed into the sea in which sea urchins and crabs lived.

In the sand of the amber beds are found numerous pebbles or pieces of compact stone, which is evidently the parent rock of the green sand, as it is composed of exactly similar granules of



Geological Section of the Amber Coast of Samland.

quartz bound together by a marly cement. The amber earth also abounds in fragments of rock known as chalk marl, which contain Cretaceous fossils.

The same rock is found on the Island of Bornholm in the Bal-

tic, and belongs to the Cretaceous. It is therefore proved that the Tertiary glauconitic sand has been made up of the green sand of the Cretaceous formation. Therefore the trees yielding the amber resin must have grown upon the green sand beds of the Cretaceous which then formed the shores of the estuary where the lower division of the Tertiary accumulated. Zaddach assumes that at that time the coast sank slowly, and the forest soil being washed by the waves the amber was carried into the sea.

Immediately over these amber-producing strata rest the beds of the Brown Coal formation, the fossil plants of which differ entirely from the amber flora. Finally, Prussia was laid dry by an upheaval of the rocks, and this ended for a time the recorded history of the country.

Now ensued a new period in the geological history of Samland, when the climate and all the conditions of the country were changed. The mountains of the north which projected out of the sea were covered with glaciers that extended down to the water.

Icebergs laden with the finer débris of rocks and blocks of stone, were detached from these glaciers and drifted to the south, passing over land formed of Cretaceous strata. Without doubt there remained a considerable deposit of amber upon this green sand bed of the Cretaceous formation where the old forest soil still existed. By the icebergs this soil was now broken up and the amber brought down and scattered in every direction.

Thus the fact is explained that amber nests are found in the quaternary deposits over all the plains of northern Europe.

This epitome of Prof. Zaddach's report seems to settle the question as to the birthplace of amber in Germany, and contradicts entirely the generally received opinion that it is the product of the Brown Coal formation, and also the theory of Dr. Feuchtwänger, that marine amber was a later deposit or formation than terrestrial.

It is apparent that the gum of the amber trees flowed out as a viscid sap to which all small objects, leaves, twigs, insects, etc., that came in contact with it adhered. Subsequent exudation covered these and preserved them more perfectly than was possible by any other method. In this way vast numbers of insects were hermetically sealed up, over eight hundred species having been discovered and many groups yet remaining to be studied.

These give us much interesting information in regard not only

to the insect life of the amber age, but afford valuable information in regard to the history of many of our living species and groups (see Heer's description of amber insects). These species are now mostly extinct but have affinity with tropical forms. A very interesting collection of these most ancient mummies can be seen in the British Museum. A classic spider is at Amherst, and in my own collection is a lizard so perfectly embalmed that the animal tissues can be seen, as also the liquid contained in the stomach; this little curio has the honor of having been christened by Prof. Agassiz.

Prof. H. R. Goeppert has made a study of the remains of plants found in amber, and has identified one hundred and sixty-three species, all of which are now extinct. Mr. Kaldenberg, of New York, has specimens of amber containing bark, water and various insects.

After mining, amber is kept temporarily in vaults near the amber localities. Rosa narrates that he entered one of the vaults of the Pächter Douglas, where he saw the yearly products arranged according to their size and quality in chests and baskets, and saw records containing the yearly results back to 1500. The worth of the pieces varies according to the size and perfection.

For the trade it is divided into classes, the best pieces being generally sent in the rough to Constantinople, where they are used for the mouth-pieces of pipes, as it is still believed there that amber possesses properties preventing contagion, and as the pipes of this ease-loving people are lighted by domestics, the amber tips to the long stems are considered a prudent caution. This trade with Constantinople is very ancient and still continues over the same route as a thousand years ago.

The smaller sized pure pieces are used for beads and the very impure for the distillation of succinic acid, the residue or refuse is the *colophonium-succini* employed in the preparation of varnish. The varnish made from amber has long been considered the finest, but other resins are now its rivals, and varied are the secrets of this prosperous trade. With amateurs at work all over the land we may hope that even the secret of Stradivarius may yet come to light!

The chemical analyses of all resins, both fossil and recent, differ very slightly. Certain varieties of amber, copal, mastic, etc., giv-

ing nearly the same atomic ratio as will be seen from the following table:

	Carbon.	Hydrogen.	Oxygen.
Amber	10	8	1
Retinite	12	9	1
Copal	10	9	1
Mastic	10	8	1
Elaterite	10	8	1
Fichtelite	8	6	1
Ambrite	16	13	1

The conclusion is that their differences consist in the arrangement of their molecules and not in their composition or even age.

Amber may be distinguished from the other resins by its hardness, its lesser brittleness and the much higher temperature required to reduce it, and also its greater electric action, but the difference is quickly discovered in the attempt to cut and polish, as the ordinary resins become in the process so heated and softened as in a measure to prevent their use for ornamental purposes. Copal jewelry is, however, occasionally made, but it soon loses its lustre.

A property of amber not generally known is its flexibility at certain temperatures. Formerly when amber required bending it was softened by placing it in warm linseed oil, and it could then be bent in to a required form. For changing the form of amber the method at present used in our extensive manufactory in this city, is simply to hold the amber over a lamp and draw it out slowly by hand. Although this process is very difficult and slow, the results are marvelous.

A pipe stem nineteen inches long has been in this way drawn out of a coil of amber about six by four inches in size or fifteen inches in circumference.

At the same factory can be seen all the process of working amber which, owing to its low degree of hardness, is wrought with the turning lathe after having first been cut with a knife and filed into something approaching the form required. It is then polished in the lathe or by hand with pumice stone, whiting and alcohol. The chippings and amber dust left from the cutting are used for varnish or incense. The Orientals, especially the Chinese, consider the burning of the odoriferous amber the highest mark of respect possible to pay a stranger or distinguished guest, and the more they burn the more marked is their expression of esteem.

We find in King's work on gems, the following: "A large amber cup, holding half a pint, has lately been discovered deposited in a tumulus in Ireland, which, from its size could hardly have been cut out of a single block of that substance. It has been ascertained by experiment that bits of amber boiled in turpentine can be reduced to a paste, united and molded into any form desired."

In Feuchtwänger on gems, we also find similar assertions regarding the melting and reforming of amber. Both King and Feuchtwänger are in error on this point. If amber were ever thus melted and molded, the art has certainly been lost.

Repeated experiments have failed to produce such a result, although a recent German scientific journal informs us that a patent for such a discovery has been applied for. An art so valuable, if successful, would certainly insure a fortune to the inventor. Nor is it necessary to have recourse to such a theory in order to account for the cup exhumed from the Irish tumulus. Alexander, Czar of all the Russians, owns a tea-set cut from blocks of this precious material. I have seen rough specimens both in the Berlin and Vienna museums larger than would have been required for the cup alluded to.

The imitations of amber are various. Glass paste is sometimes used, another composition is of turpentine and caoutchouc, still another, linseed oil, gum mastic and litharge, to which finely powdered copal is added to give the appearance of veins, add to this, ants of decalcomania, and we have the material of the cigar-holders which so deceived the uninitiated during our exhibition at Philadelphia. The most perfect imitation is the uncolored celluloid. Abbé Haüy gives the following mode of detecting or identifying amber: "Attach a fragment to a knife, and when inflamed the amber will burn with some noise and ebulition, but without liquifying so as to flow, whereas all other resins and compositions melt and drop." A better method is perhaps the electrometer.

Very little amber has as yet been found in the United States. Gay Head, Martha's Vineyard, Camden, N. J., and Cape Sable only are mentioned as its localities. A barrel full of small pieces was taken out of the green sand in New Jersey, which through some mistake was burned.

Let us hope for the accident which may yet reveal to us hidden

stores of this interesting substance with a less primitive fate in reserve for it.

While the color of amber is generally yellow it occurs in all shades, from pure white to "black." The *Falernian*, from the wine of that name, was the favorite color among the Romans. Dice of the white variety are hardly distinguishable from ivory.

At Constantinople a pipe-stem of the milk-white variety is prized by the Turks at from forty to a hundred dollars. The action of sulphuric acid on the yellow changes it to red. A beautiful specimen of green amber has been found on the American coast. "Black amber," which was a vexed question in the middle ages, returns to question us again to-day. Monsieur le Conte de Borch, in his letters from Sicily, within the last decade, says that "black amber is common."

Stretter, the latest English authority on gems, also gives black amber; but a very careful analysis of the black amber which has recently been imported from Spain to be manufactured in New York, gives: Carbon, 82.57; hydrogen, 7.70; oxygen and nitrogen, 9.08; ash, .65.. A result so different from true amber, and on distillation yielding no succinic acid, is, therefore, not true amber, but either a superior variety of jet or a highly oxidized bitumen. In chemical composition it seems to occupy an intermediate position between cannel coal and torbanite.

Subjected to the microscope, woody fibre is visible, replaced in part by resin. Its electric power is great, and admitting as it does of a remarkable polish, its lightness well adapts it for ornamental purposes.

Among the old accounts of journeyings in search of amber, we find the first mention of the Teutons as a race. As the search for an "El Dorado" led to voyages of discovery in later times, so we find that voyages and pilgrimages to the land of amber were made dating back to 1500 years before Christ. Peschel says, "Preach aloud the fact that the migrations of nations depend on the existence of the substantial treasures of the earth." So this Prussian paradise had been visited by Pythias of Massilena four hundred years before Christ, also by Theophrastus, the naturalist and philosopher, and by Philomen, the Greek poet. Nero sent there his Roman knights, who brought back quantities of amber to enrich his treasury, and a small image in this precious material was valued higher than a human slave.

Amber was intermingled with the myths and religion of the Greeks, their legends ascribing its origin to

> "* * * * the sweet tears shed
> By fair Heliades—Apollo's daughters,
> When their rash brother down the welkin sped,
> Lashing his father's sun team, and fell dead
> In Euxine waters."

Amber literature is of great interest to the virtuoso. Books in all languages refer to its many supposed qualities, and the insects contained in it have given rise to many quaint metaphors which still exist. Martial (A. D. 43) wrote in Latin: "The bee is inclosed and shines preserved in a tear of the sisters of Phæton, so it seems enshrined in its own nectar. It has obtained a worthy reward for its great toils—we may suppose that the bee itself would have desired such a death."

Thomas May (1640) thus translates this:

> "Here shines a bee, inclosed in an amber tomb,
> As if interred in her own honey comb—
> A fit reward fate to her labors gave,
> No other death would she have wished to have."

Hay in the same century translates it thus:

> "The bee inclosed and through the amber shown,
> Seems buried in a juice that was her own;
> So honored was a life in labor spent,
> Such might she wish to have her monument."

Sir John Denham (1640) wrote of streams,

> "Whose foam is amber and whose gravel gold."

In the Nibelungen Lied we find Hagentronje with his amber girdle; the dragon's blood armor of Siegfried is also supposed to have been amber; and Brunhilde mentions the amber-colored flower.

Byron alludes to amber in the "Island," and Pope speaking of Sir Plume,

> "Of amber snuff-box justly vain."

Also in his prologue to the satires,

> "Pretty in amber to observe the forms
> Of flies and ants and bees and bugs and worms;
> The things we know are neither rich nor rare,
> But wonder how the d—l they got there."

Milton apostrophizes a bee in amber, and Moore revels in amber imagery.

Modern authors have written of the weird "amber witch," and of "amber gods," and to-day a lizard in amber is thus addressed:

"Who pinioned thy grotesque and uncouth frame
Within the sunshine of this golden chamber?
Is this the fountain whence the nectar came?
Or is it star born, this undying flame
Which men call amber?

"Splay-footed sprawler from the unknown seas,
Oh, tawny cousin of the Ichthyosaurus—
What sportive sister of Hesperides,
In the ambrosia of celestial trees,
Embalmed thee for us?"

So questions the poet, but if we might invoke this "Ancient Mariner" from out his crystal coffin, more serious would be the questions we would bid him solve.

But though speechless, he bears a silent witness, for as one of the many hieroglyphics of the language of geology, underneath its Rosetta wand, he helps to reveal the history of our earth.

Thrice happy the gifted mortal, who, wielding this magic wand, can lift the veil and translate these mystic symbols of the too long "dusky past."

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— We recommend to the attention of members of the National Congress who are interested in the intellectual progress of the country, the character of the tariff on specimens, apparatus and books necessary for instruction in the sciences. These objects are only allowed to enter the country free of duty when *not intended for sale*. This practically prohibits any but wealthy citizens and institutions from possessing collections of the natural products of all parts of the earth excepting the United States, a restriction extremely disadvantageous in all directions. The majority of American students are not able to visit Europe for the purpose of making purchases, nor are they able to pay the increased rates which must be demanded by dealers who should bring their specimens here. The result is that foreign collections from all parts of the world pass by our country to go to the various European cities, large and small. This is one of the causes to which we can ascribe the ignorance of natural history which is so general in American Society as compared with that of Germany and some other parts of Europe. The amount of revenue derived from such importations must be practically nothing, while the

injury to useful pursuits and amusements is great. All such objects should be allowed to enter the country free of duty.

—— It has again become the unpleasant duty of the Philadelphia Board of Education to report where and how another reduction of the salaries of the teachers shall be made. We had hoped that they would have reported that no reduction was practicable. Philadelphia has long enjoyed the unenviable preëminence of paying its teachers less than any city of importance in the country. It is true that owing to the exigencies of the times two or three years ago, the salaries were lowered in several of our cities, but now that times have changed, the original rates should be restored. Instead of this our city governors wish to reduce the figures still lower. If the former situation was discreditable, what shall we say of the present movement? Councilmen perhaps do not know that teachers have a market value like any other kind of skilled labor, and that the city will get exactly what it pays for; also that they can in consequence produce such a community as they pay for. If they will only employ poor workmen, or a large percentage of such, they will turn out a community which will become the ready victims of all the evils that mental development and training is able to prevent, and which will not produce those intellectual fruits and flowers which so sustain and beautify human life. Not but that we have many excellent workmen in our corps of teachers to-day, but how long can we expect them to remain in a locality or even a profession where they are subjected to such vicissitudes. The character of the profession must inevitably deteriorate in every way under the present system.

The work of conscientious teachers under such circumstances has been, and is, missionary work, and their recompense the consciousness of awaking interest in matters tending to benefit thousands of pupils and teachers immediately and directly, and of affecting the community to be made up of these pupils in the future. The interest and zeal and energy of many of the teachers have been strong—sufficiently strong to carry them along in spite of opposition and obstacles always designed to prevent innovations and reforms. After a time came a reduction of seven-eights per cent. or $125 in their salaries. At the end of next year the scale of salaries will reduce their salaries again about $125, and now comes a reduction amounting to eight-twelfths per cent. or about $150. One of the consequences has been that one after another of these earnest teachers has lost heart and has dropped out, leaving the proposed plans to be worked out by somebody else, or to be dropped altogether. Their efforts have not been appreciated as they should be. If they are not compensated for their regular school work, why should they do more work for less pay? Why not render service commensurate with the wages paid?

Why increase cares and anxiety? Why not let things move along as best they may? WHAT IS THE USE?

We fear that a feeling of apathy may fall upon the stronger and more zealous teachers, as it has already seized upon the average teacher, and is always found with the idle, careless, or incompetent ones.

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RECENT LITERATURE.

DANA'S MANUAL OF GEOLOGY, THIRD EDITION.[1]—The merits of this work as a school-book are well known, and in the present edition they are decidedly enhanced. This is partly due to the introduction of the latest determinations in stratigraphic geology in the West. We observe with pleasure that Prof. Dana has adhered with impartial justice to the law of priority in the nomenclature of the formations of the interior of the continent, in spite of the attempts made by some writers to introduce names of their own, regardless of this necessary safeguard. The value of the work is also increased by the introduction of additional engravings, especially of those representing some of Prof. Marsh's discoveries in the West. It is true the author might have derived some aid from other sources, especially as regards the skull of *Coryphodon*, of which he gives a figure which is quite inaccurate.

We cannot speak in as high terms of the manner in which the palæontology of Vertebrata is represented in the new edition of the manual. It displays little acquaintance with what has been done in this field in North America since 1872, and that includes three-fourths of the entire subject. Thus the greater part of all the principal modern discoveries in the Permian, Triassic, Postcretaceous, Suessonian and Pliocene faunæ are not alluded to, while not a few of those in the Jurassic and Suessonian formations are attributed to other than the original discoverers. The nomenclature employed is that of the vertebrate palæontological papers published in the *American Journal of Science and Arts*, which is notoriously regardless of the rule that names must be only proposed to represent work done, and may not be proposed to secure credit for work yet *to be done*. It is discouraging to the student to be expected to remember names which cannot be used either because they are synonymes or do not refer to necessary descriptions.

THE REFUTATION OF DARWINISM.[2]—This book is an excellent illustration, if one were needed, of the futility of persons writing on the question of evolution who are not themselves experts in

[1] *Manual of Geology*, etc., with especial reference to American Geological History. New York, Ivison, Blakeman, Taylor & Co., 1880.

[2] *The Refutation of Darwinism, and the converse theory of Development, based exclusively upon Darwin's facts, etc.* By T. WARREN O'NEILL, member of the Philadelphia Bar. J. B. Lippincott & Co., 1880.

some branch of natural science. A work founded "exclusively upon Darwin's facts," must of necessity strike wide of the mark, for many of the most important evidences for evolution are not to be found, or are barely mentioned in Darwin's works. That Darwinism is not the whole doctrine of evolution is perceived clearly enough by Mr. O'Neill, who devotes two or three opening chapters to a lucid exposition of the well known fact that Natural Selection does not explain the origin of characters. This truth has for twelve years been maintained by the editors of this journal, as well as by others, and has been epitomized in the statement that "the origin of the fittest" is the primary problem of evolution, while the "survival of the fittest" (Darwinism) is secondary.

Mr. O'Neill's "Refutation of Darwinism," however, consists principally of a theory of his own, which is an extension of the principle of reversion to all kinds of variation now observed in domesticated animals; he does not concern himself so much with the wild ones, as they are not so fully considered in Darwin's works. In brief, Mr. O'Neill believes that the present condition of animals is one of degradation from a condition of primitive perfection, which has been brought about by the severity of the struggle for existence! The whole theory is a readaptation of modern knowledge to the mediæval idea of the creation and its degradation, consequent on the fall of man.

There are two little difficulties in the way of this hypothesis. Firstly: since the doctrine of evolution is an attempted explanation of the "origin of species," etc., etc., Mr. O'Neill's work is entirely irrelevant, if true. By reversion he only brings us back to species in their pristine completeness or "physiological integrity," as he calls it; the question of how they attained this condition is not considered. It is fair to add that Mr. O'Neill promises us a work on this subject in a foot note on page 435, which will be, if the author's expectations are realized, a wonderful work indeed.

The second difficulty is presented by the science of palæontology. One should look here for the evidences of reversion to older types, should such have been the law of the later creation. But Mr. O'Neill does not concern himself with this subject. When he does so he will find his primitive "physiological integrity" to be a myth; that development is by divergent advances, not by reversion; and that a struggle for existence, not too severe, has been an agent of good, not of evil.

The book is written in a pleasant style and the author is sometimes witty at Mr. Darwin's expense.

Hallez's Natural History of Turbellarian Worms.[1]—The first of this series was the elaborate researches on the embryology

[1] *Travaux de l'Institut Zoologique de Lille et de la Station maritime de Wimereux.* Fascicule II. Contributions a l'histoire naturelle des Turbellariés. Par Paul Hallez. Lille, 1879. 4to, pp. 213, 11 plates.

of Bryozoa, by J. Barrois; the present memoir is concerned with the structure of several Turbellarian worms, and is particularly valuable as giving detailed and well illustrated life histories of *Eurylepta auriculata*, *Leptoplana tremellaris*, with fragmentary but still important embryological details on certain Rhabdocœlous worms, with especial reference to the early history of the egg. He describes the lasso cells of some of the worms, remarkably like those of the jelly-fish, and discusses the process of strobilation in a Microstomum.

WESTWOOD'S SYNOPSIS OF URANIIDÆ.[1]—This is a finely illustrated essay on the systematic position of this small but interesting group of moths. By Guenée they were placed at the head of the Phalænidæ, in which view he was followed by Packard. Prof. Westwood, however, on account of differences in the venation of the wings, and the fact that the larvæ are not loopers, but have sixteen legs instead, or fourteen as with a very few Geometiid larvæ, believes that the group should be placed at a distance from the Geometridæ and amongst the Bombycidæ.

THE ZOÖLOGICAL RECORD FOR 1877.[2]—This well known publication of the Zoölogical Record Association, and which has now become almost absolutely indispensable to working naturalists, deserves more than a mere passing notice. Under the heads of twenty-two classes and orders, the progress of Zoölogy for the year past in all departments is reviewed by specialists competent, from their bibliographical attainments and training in their respective departments, to carry out the work satisfactorily. Under each head the contents of the more important papers, general and special, are given with references to their place of publication. The mammalia have been done by Edward Richard Alston; Aves, by Howard Saunders; Reptilia and Pisces, by A. W. E. O'Shaughnessy; Mollusca and Molluscoida, by Prof. Edward von Martens; Crustacea, by Prof. von Martens; Arachnida and Myriopoda, by Rev. O. P. Cambridge; Insecta, general subject, by E. C. Rye, together with Coleoptera, Hymenoptera, Diptera and Rhynchota; Lepidoptera, by W. F. Kirby; Neuroptera and Orthoptera, by R. McLachlan; Vermes, by F. Jeffiey Bell; Echinodermata and Cœlenterata, by C. F. Lûtken; Spongida and Protozoa, by Stuart O. Ridley. Most of these names are exceedingly familiar to naturalists and are a sufficient guarantee of the character of the book. It is a work which may be deservedly encour-

[1] *Observations on the Uraniidæ, a family of Lepidopterous Insects, with a Synopsis of the Family and a Monograph of Coronidia, one of the genera of which it is composed.* By J. O. WESTWOOD. (From the Transactions of the Zoölogical Society, X, Part XII, 1879.) June 1st, 4to, pp. 35, 3 plates.

[2] *The Zoölogical Record* for 1877; being volume fourteenth of the Record of Zoölogical Literature. Edited by Edward Caldwell Rye, F. Z. S., M. E. S., etc., 8vo., pp. 24, 59, 11, 30, 97, 36, 20, 1, 234, 20, 11, 18, 8, 12, London, John Van Voorst, Paternoster Row, 1879.

aged. The subscription price of the annual volumes is £1, 10s, to the public.

LEIDY'S RHIZOPODS OF NORTH AMERICA.[1]—This magnificent volume, with its wealth of illustration, is the fruits of four years of constant study of the fresh-water Rhizopods of this country. The author has not only studied them in the Western Territories, but also at various points along the Atlantic coast from Nova Scotia to Philadelphia. The Rhizopods are the lowest forms of life with the exception of the Monera of Haeckel, of which but a single species has been detected by Prof. Leidy in this country. As a full and thoroughly well illustrated account of these organism this volume will prove of service to the general public interested in the discussions regarding protoplasm, for here are pictured with wonderful accuracy and grace these animated bits of protoplasm; to the teacher, who cannot always command even a single Amœba and much less a series of them, here is presented on a single plate the *Amœba proteus* in a dozen different attitudes, drawn in colors, in some cases half as large as one's hand; and this plate is succeeded by forty-seven colored chromo-lithographs, well engraved, though we doubt not falling far short of the exquisite original sketches of the author, who is not excelled by any living naturalist or zoölogical artist in the accuracy and artistic finish of his drawings.

Moreover the study of these minute changeable protean forms is most difficult in itself, and their truthful representation still more so. While, then, the volume has a high philosophical and educational value, it will stimulate naturalists to cultivate this field, and to elucidate the modes of development of these forms. To the palæontologist the work will have a high value, since allied or possibly the same shelled forms may be discovered in the lake formations of the Western Territories. This work forms, consequently, one of the most important volumes of final reports of the great survey now unfortunately closed, and which has done so much to spread among our people a knowledge of the natural resources of the Western Territories. Biology embraces palæontology, the latter is more than half of geology, so that no scientific geological survey can do its work properly without reference to these sciences. The cost to the survey of the field work, the press-work, and, we believe, the illustrations of this volume were but nominal, the printing of the volume with the necessary illustrations having been separately ordered by Congress. As the author states, "Whatever may be thought of the pertinence of publishing such works as the present one with the Reports of the Geological Survey of the Territories, to remove any misapprehension in the matter I deem it proper to state that my contributions have been

[1] *Report of the United States Geological Survey of the Territories.* Vol. XII, F. V. Hayden, in charge. Fresh-water Rhizopods of North America. By JOSEPH LEIDY, M.D. Washington, 1879. 4to, pp. 324, 48 plates.

given without pecuniary recompense. In my own judgment, Prof. Hayden has acted with the most enlightened view in authorizing and encouraging such natural history investigations as would be facilitated by explorations of the country in which his geological surveys were conducted. With the exception of the cost of publishing the present report, the only additional expense to which I put the survey during my explorations in the West amounted to about $222." The same may be said of at least one other of the bulky quarto volumes of the survey, and we suppose of others.

The number of species of these fresh-water Rhizopods living in our country is unexpectedly large; numbers of them are common to Europe and North America, and many are found not only in the Eastern States but also in the lakes of the Uintah mountains of Wyoming, showing that the forms are well nigh cosmopolitan. They occur in the summer time on the under side of floating leaves of water plants and especially among Sphagnum moss. "A drop of water squeezed from a little pinch of bog-moss has often yielded scores of half a dozen genera and a greater number of species."

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GENERAL NOTES.

BOTANY.

SEXUAL DIFFERENTIATION IN EPIGÆA REPENS.[1]—The following remarks on *Epigæa repens* are contained in Gray's "Synoptical Flora of North America," under the generic description of that plant:

"The flowers are heteromorphous and inclined to be diœcious, or diœcio-dimorphous. Those with fully polliniferous anthers seldom set fruit; their stigmas short, erect, slightly projecting beyond the margin of the five-toothed ring (to the teeth of which they are severally adnate), the style sometimes longer than the stamens and projecting, sometimes shorter and included. Fully fertile flowers on other plants; their styles (as in the former sort sometimes long and exserted, sometimes shorter and included) with stigmas elongated and much surpassing the ring, short, linear, glutinous, radiately divergent; their stamens either slightly polliniferous, or reduced to abortive filaments, or even wanting."

In the early spring of this year I took occasion to make some careful observations on this plant as it occurs in the vicinity of Washington City, the results of which, though in the main confirmatory of this description, differ from it in some respects, and afford some additional facts of special interest.

I desire to premise that these variances and additional peculiarities are doubtless due to differences of habit in different localities, and not to any lack of fidelity in description.

The principal deviation which I detected from the description which I have quoted, was in the styles and stigmas. I found no heterostyly; the length of the styles relatively to the flowers was about the same at all times in both forms of flowers. The stigma, however, presented a very different appearance in one form from what it did in the other. In the fertile form, in which the abortive stamens varied in all degrees, the lobes of the style were strongly divergent and of a firm texture, with evident stigmatic surfaces. In the staminate form they were never separated, but cohered tightly in an apparently solid club-shaped summit or head. I was able, however, to dissect them apart without

[1] Read before the American Association for the Advancement of Science, at Saratoga, N. Y., September 1, 1879, by Lester F. Ward, A.M.

lesion, and satisfy myself that they were entirely functionless, possessing no stigmatic surfaces.

The important *addition* which my observations furnished to the facts described by Prof. Gray, consisted in the discovery that the dimorphism of the flowers extends in a marked degree to their *dimensions*. The staminate flowers are, in all respects, much larger than the fertile ones. As this fact at first appeared quite remarkable, I took great pains to verify it, making my comparisons from specimens taken from localities widely separated, and repeating the observations a great many times throughout the flowering season of the plant. It grows on gravelly slopes in small areas or patches, and all the flowers in a patch were invariably found to be of the same kind, either all staminate or all fertile, as if all came from the same root, as no doubt they do.

The amount of surface covered by staminate plants was found greatly to exceed that covered by the fertile ones. It thus often required considerable search to find a patch of fertile flowers, but a little practice was sufficient to render their detection easy from the diminished size and conspicuousness of the flowers. This difference does not consist merely in the greater vigor and turgidity of the staminate form, but represents an actual discrepancy in the measurements of all the parts of the flower, amounting to about thirty per cent. in the length and about forty per cent. in the width of the corolla. The exact dimensions, as taken from typical specimens, were as follows:

Length of flower including calyx and limb of corolla:		
In staminate form	16	millimeters.
In fertile form	12	"
Width of corolla tube split through and laid open:		
In staminate form	11	"
In fertile form	7	"
Width of limb of corolla laid open in the same manner:		
In staminate form	15	"
In fertile form	9	"
Length of the pistil, including ovary and stigma:		
In staminate form	9	"
In fertile form	7	"
Length of perfect stamens	9	"
Length of sterile filaments	3	"

The staminate form appears never to develop fruit, although the ovary contains ovules. The fertile form, besides being much more rare in actual amount at flowering time, and possessing decidedly less fragrance, also often fails to fruit. It is, therefore, only quite rarely that fruiting specimens can be found. I attribute this, however, to the failure of most of the fertile flowers to receive any pollen. The two forms are often not in close proximity. They bloom very early in the spring, before most of the flying insects appear. The flowers are always close to the ground, with their open end more frequently inclining downward than upward, and most of them are concealed under the foliage so as to

be invisible from above. Yet, as we have seen, their self-fertilization is impossible. These and other facts have led me to the conclusion that, where fertilized at all, it is chiefly done by ants, which, on the theory, now generally accepted by entomologists, of the possession by that insect of a keen sense of smell, would sufficiently account for the exquisite fragrance of the flowers of Epigæa. I have failed entirely to find insects within the corolla, but this, so far from causing doubts that it is fertilized by insect agency, simply helps us to understand why it bears fruit so sparingly.

The facts which I have stated, even if they were entirely new, which they probably are not, might not, perhaps, in themselves have justified me in claiming for them the attention of this association. For my own part I am far more interested in the important principles which they illustrate, and it is for the purpose of stating these principles, supported by such an example, that I have been led to present the facts.

Besides affording an instructive example of the many ways in which plants are dependent upon insects, Epigæa well illustrates the process of sexual differentiation which is going on in a great many species of plants. In the maples it has not yet advanced so far; in Smilax it has gone somewhat farther, while in the willow it has reached completeness. It is in these intermediate stages that the phenomena are most interesting, and the botanist, contemplating a great number of these, differing by small degrees, can almost see the process in operation. The phenomena of dimorphism, as it exists in Houstonia, must probably be regarded as one of the initial steps in the direction of ultimate diœcism, or complete separation of the sexes.

In this respect, as in many others, we find that nature cannot be assumed to have reached its final and fixed condition, but that the existing state of things must be regarded as dynamic; the movements in the past which have made things what they are, still continue to effect changes in them. There is a sort of *uniformitarianism* in biology as well as in geology, and the law of "present causes" is as potent in explaining the existing condition of plants and animals as it is that of coast lines or mountains.

Hermaphroditism, or self-fecundation, seems to be a thraldom necessary at the outset, but from which all living things are seeking to escape. The animal kingdom has, for the most part, thrown off this yoke, chiefly through the development of the sexual instinct. The vegetable world still groans heavily under it, but it is now looking to insects as its liberators, and the little flower which I have figured here, shows one of the many ways in which these creatures perform this service.

THE AGENCY OF INSECTS IN FERTILIZATION.[1]—I present some additional notes taken from papers prepared by some of my young students while working under my direction.

Mr. A. J. Chappell studied a healthy plant of *Lythrum salicaria.* The flowers of the species are trimorphous. The plant studied was one which produced short stamens and those of medium length and a long style. In the bed, these organs are bent or curved so that the anthers and stigmas are included within the calyx. The anthers all ripen at about the same time, sometimes before the flower opens.

Bees visit the plant freely. Their heads are covered with pollen from the stamens; the thorax with pollen from the stamens of medium length.

Some of the pollen thus collected on the insect is carried to the long pistils. Pollen was found on all the stigmas, but Mr. Chappell observed *that after a few days each pistil in turn after the flower had opened, wilted and fell off.*

Mr. E. A. Murphy found several kinds of insects about the Lythrum above mentioned. He was also surprised to see all the pistils, after they had been exposed for a few days, wilt and fall off. The plant was making a fair growth, and did not suffer from dry weather or a surplus of moisture.

Mr. J. T. Elliott studied *Apocynum androsæmifolium.* The anthers are shaped somewhat like an arrow-point. All the anthers form a sort of pyramid about the pistils. An abundance of honey attracts many insects. The groove between the lobes of the anthers often catch and hold small bees by the tongue, much as a tapering crack between two boards would hold a rope. Small wild bees pull out the masses of pollen which come in pairs.

Some flowers were tied up to keep all insects away. In some cases after a few days, the bell-shaped corolla was full and overflowing with nectar. These were artificially fertilized, some with pollen of the same flower; others with pollen from other flowers. Some were kept covered without artificial aid in transferring pollen. All were covered again. Those pistils where the stigmas were supplied with pollen set fruit.

Mr. W. A. Burgess tried similar experiments with similar results.

Mr. J. H. Irish observed the flowers of catmint. When the anthers are discharging their pollen, they are clustered around and a little above the pistil. When the pistil is ready to secure the pollen, it reaches above the stamens and spreads its stigmas apart. At this time the anthers are dead and slightly curled down. The stigmas are just in position to touch the back of an insect where it has previously collected pollen from anthers of a younger flower.

[1] Notes from some of the papers of students at Michigan Agricultural College. Abstracts made by Prof. W. J. Beal.

In several cases, flowers were tied up with sarles which kept insects away. No seeds set.

Insects fertilize *Nepeta nuda* in the same manner as they do the catmint.

Mr. Geo. Young found that the flowers of *Nepeta mussini* were also proterandrous and that they were fertilized essentially in the same way as the two species above mentioned. He sprinkled some chalk dust on the back of a bee and soon found that it had come back for more honey. *Salvia Japonica*, *Teucrium Canadense*, thyme, and motherwort were fertilized in the same manner.

A number of spikes of *Teucrium* before flowering were tied up in bags. None of these set seeds. Other spikes were tied up in a similar way. The latter were several times violently shaken without taking off the covers. This caused about one-fifth of the flowers to set seeds.

The fertilization of *Plantago lanceolata* and *P. major* have before been described. The flowers are in spikes. The pistils appear some time before the stamens which are long and reach some distance up the spike. The pollen is dry and the plant is usually described as dependent on the wind for aid in transferring from one flower to another.

Several students have seen honey bees and other wild bees, bugs and flies in considerable numbers about the flowers of *Plantago lanceolata*. These insects, except the bugs, seem to be after the pollen.

Mr. Avery covered buds of *Asclepias cornuti* and they set no fruit. Not all insects about this plant aid in the fertilization. He saw some insects held fast by pollen which they were not stout enough to pull out. Some left their legs and had escaped. Ants get fast sometimes. They were seen to liberate their feet with their jaws.

Mr. L. Wilcox found the flowers of the common teasel proterandrous and dependent on various insects for fertilization.

Mr. H. I. Penoyer finds that the flowers of *Mimulus ringens* are not self-fertilizing but depend on the aid of insects. Detailed experiments were made to prove the statement.

Mr. J. E. Coulter removed the young stamens from flowers of *Scrophularia nodosa* and found that the pistils were fertilized in some way by receiving pollen from other flowers. He also tied up some flowers with paper bags and found that they did not set fruit. Mr. J. R. Shelton removed the stamens from five opening buds, and tied over them a paper bag. After a few days they began to enlarge and develop seeds. He covered five buds not artificially fertilized and they set no fruit. This plant is proterandrous and well described and illustrated in Dr. Gray's neat little book, " How Plants Behave."

Mr. W. E. Hale found that the flower buds of *Campanula rotundifolia* all blasted if tied in paper sacks. It has often been

shown that the stamens shed their pollen on the outside of the style before the stigmas are open.

Mr. W. H. Goss tied paper sacks about flowers of *Lobelia spicata*; none of them bore seeds. From others he cut away the young anthers while very small. The latter were left exposed and all fruited.

Mr. C. A. Ward, on the flowers of *Martynia proboscidia* has seen bumble bees, honey bees and another wild bee. Bumble bees were seen to enter the flowers. The stigmas closed before the bees backed out. The quickest time observed for the closing of the stigmas was *three seconds.* It took this six minutes to open again. The longest time for closing of stigmas was twelve seconds, and this occurred on a cool, cloudy day. He says, " It always took twice as many minutes to open as it did seconds to close. After about five trials made in succession, the stigmas refused to act, as if they were tired out."

Mrs. F. A. Gulley, during two weeks of very hot, dry weather, watched a patch of white clover, every day at different times, and never saw an insect near it. At the end of that time, she examined fifty of the heads, twenty-eight of which had no seeds. In the other twenty-two heads there were two or three, and sometimes five or six of the flowers which contained seeds. Previous to dry weather, bumble-bees were abundant on the flowers and these seeded freely.

Mr. E. A. Burke studied the flowers of Indian corn. In nearly all cases, the pollen begins to fall two or three days before the stigmas appear. The first pollen is discharged from the central spike of the tassel and last at the base of the lower or side spikes. The plant sheds pollen continuously for five to eight days. Small bugs seem to be after the pollen.

Mr. A. C. Redding also studied Indian corn. In forty-eight cases out of fifty, the staminate flowers appeared from two to three days before the pistillate flowers. The anthers shed pollen within twenty-four hours after they appeared. The pistils are ready to be fertilized in a few hours after they appear. To prove this, he tied cloths over the whole ear after the pistils had been out for a few hours. In each case the ovules developed. He also tied up some before the stigmas appeared and fertilized them artificially. The kernels all set.

Bees, wasps and other bugs visit the stamens. If the stigmas are soon ready for fertilization after they appear, they are in nearly all cases crossed by pollen from other stalks.

Mr. A. G. Jack observed the flowers of *Epilobium coloratum.* It is well known that *E. angustifolium* is proterandrous or at least most of the stamens are ripe before the stigmas appear. The former plant under consideration has four petals which are two-lobed. It has eight stamens, four of which are long and four short. The four long stamens grow up close to the stigma and

adhere to it, where they discharge their pollen before withering. The four short stamens grow only about half way to the stigma. At no stage of their growth could he find them any longer. Both sets of stamens discharge their pollen at the same time. The short stamens are attached to the base of the petals and when the flowers close, the petals coming together draw the anthers of the short stamens up to the base of the stigmas. Occasionally a small green bee came to the flowers, but they all left at once, as though they had made a mistake. He tied up buds before they were open, and found that the flowers all set seeds freely.

Mr. C. H. Osband finds that the sensitive stigmas of the flowers of trumpet-creepers close in about three seconds after being touched and open in five minutes. Both insects and humming birds aid in fertilization.

THE FUNCTION OF CHLOROPHYLL.—One of the most important recent contributions to physiological botany, is contained in a recent communication to the Berlin Academy of Sciences, by Dr. Pringsheim, which appears to throw considerable fresh light on the function of chlorophyll in the life of the plant.

Having been led by previous researches to the conclusion that important results might be obtained by the use of intense light, he combined an apparatus by which the object under view should be brightly and constantly illuminated by a strong lens and a heliostat. If in this way an object containing chlorophyll—a moss-leaf, fern-prothalium, chara, conferva, or thin section of a leaf of a phanerogam—be observed, it is seen that great charges are produced in a period varying from three to six or more minutes.

The first and most striking result is the complete decomposition of the chlorophyll, so that in a few minutes the object appears as if it had been lying for some days in strong alcohol. Although however. the green color has disappeared, the corpuscles retain their structure essentially unaltered. The change then gradually extends to the other constituents of the cell; the circulation of the protoplasm is arrested; the threads of protoplasm are ruptured and the nucleus displaced; the primordial utricle contracts and becomes permeable to coloring matters; the turgidity of the cell ceases; and the cell presents, in short, all the phenomena of death.

That these effects are not due to the action of the high temperature to which the cell is exposed under these circumstances is shown by the fact that they are produced by all the different parts of the visible spectrum. The result is the same whether the light has previously passed through a red solution of iodine in carbon bisulphide, through a blue ammoniacal solution of cupric oxide, or through a green solution of cupric chloride. If the carbon disulphide solution of iodine be so concentrated that only rays of a greater wave-length than 0.00061 mm. can pass through it, these effects are not produced, although about eighty per cent. of the heat of white sunlight is transmitted. On the other hand, if the

ammoniacal solution of cupric oxide be so concentrated that the whole of the rays of a less wave-length than 0.0005·1 mm. are absorbed, a rapid and powerful effect is produced, although the amount of heat that passes is very small. It is thus seen that the phenomena in question are not the result of heat.

The next point determined by Dr. Pringsheim, is, that the effects are not produced in an atmosphere devoid of oxygen. This was the case whether the oxygen was replaced by pure hydrogen or by a mixture of hydrogen and carbon dioxide; while the removal of the carbon dioxide from atmospheric air was altogether without effect on the phenomena. The conclusion drawn is that the decomposition of chlorophyll in the living plants is a process of combustion which is influenced and promoted by the action of light, and which is not related to the decomposition of carbon dioxide by the plant. When the green color of the chlorophyll-grains has been partially destroyed, it cannot be restored, even though the cell continues to live; from which it is inferred that the result is not a normal physiological, but a pathological effect. No substance was found in the cells which might be regarded as the product of the decomposition of the chlorophyll, nor was any oil or starch detected in the etiolated cell, nor any formation of grape-sugar or dextrine. The assumption is therefore that the products of decomposition are given off in the gaseous form.

The conclusion is drawn that the decomposition produced in the protoplasm, and in the other colorless cell contents, is the direct effect of the photochemical action of light. That it is not due to the injurious influence of the products of decomposition of the coloring matter of the chlorophyll, is shown by the fact that it takes place equally in cells destitute of chlorophyll, such as the hairs on the filaments of *Tradescantia*, the stinging hairs of the nettle, &c. It is, on the other hand, dependent on the presence of oxygen, or is a phenomenon of combustion.

The results of a variety of experiments leads Dr. Pringsheim to the important and interesting conclusion that the chlorophyll acts as a protective substance to the protoplasm against the injurious influence of light, diminishing the amount of combustion, or, in other words, acting as a regulator of respiration.

He then proceeds to investigate what are the substances which become oxidized in the process of respiration. In every cell, without exception, that contains chlorophyll, Pringsheim finds a substance that can be extracted by immersion in dilute hydrochloric acid for from twelve to twenty-four hours, to which he gives the name *hypochlorin* or *hypochromyl*, and which he believes to be the primary product of the assimilation of the chlorophyll. It occurs in the form of minute viscid drops or masses of a semi-fluid consistency, which gradually change into long red-brown imperfectly crystalline needles. It is soluble in alcohol, ether,

turpentine and benzol, but insoluble in water and in a solution of sodium chloride. It becomes gradually oxidized on exposure to an imperfectly crystalline resinous substance. It is probably an ethereal oil, and an invariable accompaniment of the coloring substance of chlorophyll, and even more universally distributed than starch or oil. It has not yet been detected in those plants which do not contain true green chlorophyll, such as the Phycochromaceæ, Diatomaceæ, Fucaceæ and Florideæ. Starch and oil appear to be reserve substances produced by the oxidation of the hypochlorin caused by light, it being the most readily oxidizable constituent of the cell, more so even than chlorophyll itself.

That the hypochlorin—present in variable quantity in every chlorophyll grain under normal circumstances—is subject to continual increase and decrease, may be proved without difficulty. All comparative observations on chlorophyll grains in younger and in older conditions, point unmistakably to the conclusion that the collection and increase of the starch enclosed in the ground substance of the chlorophyll, goes on *pari passu* with a decrease of the hypochlorin. In dark, the hypochlorin, which does not take any direct part in the transport of food materials, is more permanent than starch; and this fact again is in agreement with the conclusion that its transformation in the cell into more highly oxidized bodies is hindered by the increased respiration in light.

In the facts here detailed, and the conclusions derived from them, Dr. Pringsheim believes that an entirely new light is thrown on the cause of the well-known fact that assimilation takes place only in those cells of the plant which contain chlorophyll. This substance acts universally as a moderator of respiration by its absorptive influence on light, and hence allows the opposite phenomena of respiration and elimination of carbon dioxide to go on in those cells which contain it. A more detailed account of the experiments and results is promised by the author in a future paper.—*Alfred W. Bennett.*

ZOÖLOGY.[1]

BUNDLES OF SNAKES.—The statements made by Humboldt as to the piles of snakes he saw in Guiana, can be verified here in our northern woods and swamps. I personally had the pleasure of observing it twice, both times very early in spring, and in locations which could be called wildernesses. I first saw such a bundle of snakes in the neighborhood of Ilchester, Howard Co., Md., on the stony bank of the Patapsco river, heaped together on a rock and between big stones. It was a very warm and sunny location, where a human being would scarcely disturb them. I reasoned that the warmth and silence of that secluded place

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

brought them together. Some hundreds of them could be counted, and all of them I found in a lively state of humor, hissing at me with threatening glances, with combined forces and with such a persistency that stones thrown upon them could not stop them nor alter the position of a single animal. They would make the proper movements and the stone would roll off. All the snakes in this lump were common snakes (*Eutænia sirtalis* L.). The second time I noticed a ball of black snakes (*Bascanion constrictor* L.) rolling slowly down a steep and stony hillside on the bank of the same river, but about two miles above Union Factory, Baltimore county, Md. Some of the snakes were of considerable length and thickness, and, as I noticed clearly, kept together by procreative impulses.

It is surely not agreeable to go near enough to such a wandering, living and hissing hundred-headed ball to examine the doings and actions, and search for the inner causes of such a snake association. As, furthermore, the localities for such mass-meetings of snakes are becoming rarer every year, and our rapidly increasing cultivation of the country must make it hotter for snakes everywhere, only a few naturalists could see such a sight, even if they should look for it in proper time, which, as stated above, seems to be the first warm days in spring.—*E. L., Ellicott Mills, Md.*

Reversed Melanthones.—It is a not uncommon circumstance for collectors, in taking any considerable number of the various so-called species of Melantho, to find a few of them heterostrophal, or sinistral. Dr. Kirtland, in the Ohio Report (quoted by Binney in Land and Fresh-water Shells of North America, p. 44), described one of these abnormal forms as *Paludina heterostropha*, though he evidently was not altogether clear as to its specific value, for he remarks, "I formerly considered it as a mere variety of *P. decisa* Say." This same shell Mr. Binney has referred to *Melantho ponderosus* Say. That all of these sinistral shells *are* abnormal forms of one or more of the well-known Melanthones is now conceded by most naturalists. It was with not a little surprise, therefore, that the writer recently received from a collector in Illinois a reversed shell of *M. subsolidus* Anth. labeled with the old and almost forgotten name given by Dr. Kirtland. Having collected a very large number of the three species common in New York, viz., *M. rufus* Hald., *M. integer* De Kay, and *M. decisus* Say. I wish to place on record the following observations made in the spring of 1877, with reference to the relative abundance of these reversed forms.

The method pursued was as follows: From impregnated shells, about the time of parturition, the young Melanthones were taken and separated into lots of one hundred specimens each. Every shell was then carefully inspected, and it was found in the case of *M. integer* that two per cent. of every one hundred shells were

sinistral. Of *M. rufus*, about one and one-half per cent. of every *one thousand* were thus reversed, while the per cent. of *M. decisus* was between two and two and one-half in each hundred. Comparing these averages with the number of mature reversed specimens collected through quite a long period of time, it was found that only about one-tenth of *one* per cent. survived the accidents consequent on station and environments.

How to account for the presence of sinistral shells at all now became the problem. I submit the following suggestions: Many adult and impregnated specimens were dissected and carefully studied, with the result that the position of the embryonic shells was such as to necessarily crowd them one on another. As they increased in size (this is based upon the inspection of shells in different stages of development), their proximity influenced their assumption of form, more and more, and many curious and abnormal shapes were given the growing shells. Binney (l. c., p. 49) figures some of these forms, while others have been described as species (e. g. *Paludina* (*Melantho*) *genicula* Con.). Mr. Binney very properly groups these aberrant forms under *M. decisus* or *M. integer*. These "shouldered" and otherwise deformed shells are due to the crowding mentioned above. Is it not possible that the reversed forms originate in a similar way; the embryonic shell increasing in the direction of the least, or no resistance? The direction of the "whirl" thus started, would be followed in all the succeeding stages of development.

Mr. Binney doubts the specific identity of *M. rufus* Hald., but if the usually accepted definition of "species" be allowed, without good reason. The three above-mentioned forms are associated in the Erie Canal, at Mohawk, N. Y., and so far as species go they are all valid. The latest understanding of a species would, however, relegate them all, together with the other southern and western forms of the genus, to varieties of one sole type.—*R. Ellsworth Call, School of Science, Dexter, Iowa.*

Laws of Histological Differentiation.—In a recently published article (Proc. Boston Soc. Nat. Hist., Vol. xx, p. 202) Dr. C. S. Minot discusses certain laws of histological differentiation. He maintains that, first, the most primitive form of tissue is an epithelium composed of a single row of polyhedral cells of equal height. Second, very early in the course of development the ectodermic cells become smaller and multiply faster than the cells of the entoderm. Third, the two horizontal axes of an epithelial cell (or those parallel to the surface of the epithelium) usually remain approximately equal to one another in length, while the perpendicular axis varies independently and to a much greater extent. Fourth, epitheliums increase their surface by the formation of depressions (invaginations) or of projecting folds (evaginations). Fifth, structural modifications of epitheliums usually affect similarly a whole cluster or tract of cells, but rarely isolated

cells only. Sixth, probably the primitive cells of the mesoderm are amœboid in character. For all mesodermic cells, not mechanically united with other cells, but capable of independent locomotion by amœboid movements, is proposed the collective name of "*mesamœboids*." The author concludes by saying that if these views are confirmed "we shall then have discovered primary *histological* differences between the three germinal layers in their earliest stages as follows:

EPITHELIAL.

A. Small cells, mainly protoplasmatic........................Ectoderm.
B. Large cells, with much deutoplasm.......................Entoderm.

AMŒBOID.

C. Cells free in the cavity between the two primitive layers, ecto- and entoderm ....Mesoderm.

ANT BATTLES.—I have within the past few years witnessed several battles between ants, and in some instances, the curious conduct of the captors towards their prisoners which I think is worth mentioning. The most noted battle took place July, 1878, between two colonies of red ants. The victorious army were medium in size and numbered many thousands; those captured were a much larger ant, but not so numerous. The large ants after a desperate resistance were forced out of their fort, four or five small ants holding on to the antennæ and legs of the prisoner. The captives were usually taken a few inches away from the fort and liberated. All the ants returned to the fight except one who would stand facing his captive for a few moments, then taking hold of the antennæ of the prisoner give three or four pulls; after waiting a short time the pulling was repeated with more determination; the big ant not responding, he was savagely jerked, then he would lean forward, and a drop of sweet issuing from his mouth, the little ant would approach and drink the nectar, then pick up his captive and hurry home. This was repeated many times during the battle. Some of the prisoners gave up their sweets without so much pulling. I think this battle was for no other purpose than to secure the sweets supposed to be in the stomachs of the captives. These ants were kept prisoners just one week, when they were liberated, marched off in a body and never returned. They were probably kept confined until their sweets were exhausted and then allowed to go free.—*A. Miller, North Manchester, Indiana.*

NOTES ON THE GEOGRAPHICAL DISTRIBUTION OF THE CRUSTACEA.—Mr. Miers in his excellent work on the Crustacea of New Zealand,[1] enumerated several species which were common to that country and America; these are *Neptunus sayi*, *Platyonichus bipustulatus*, *Grapsus pictus*, *G. variegatus*, *Heterograpsus crenulatus*, *Nautilograpsus minutus*, *Plagusia chabrus*, *Leiolophus planis-*

[1] Catalogue of the Stalk and Sessile-eyed Crustacea of New Zealand. Colonial Museum and Geological Survey Department, 1876.

simus, *Rhynchocinetes typus*, *Palæmon tenuicornis* Say (*natator* Auct.), *Squilla nepa*, *Sphæroma gigas*. Mr. T. W. Kirk (Trans. New Zealand Institute, IX, 474, pl. XXVII), adds *Platyonichus ocellatus* and *Squilla armata* to the list, and in a paper now before me[1] *Caprella lobata* and *Petrolisthes rupicolus* are added to the list, the latter illustrated by a figure. In a second paper[2] he reports from his Antipodal Island species before known from British seas, viz.: *Calocaris macandræ*, *Portunus pusillus* and *Fleustes panoplus*, but regarding his *Podocerus cylindricus* there may be a doubt, as our author apparently has not access to Say's description, and Spence Bate in his catalogue of Amphipodous Crustacea, describes and figures a distinct species from that of Say, as was pointed out by Smith. Say's type is no longer in existence.

Mr. Wood Mason (the exact reference I have not at hand) reports *Carcinus mænas* from India, and Spence Bate in J. K. Lord's "Naturalist in Vancouver" reports the well known *Gelasimus annulipes* of the east coast of the eastern continent from Vancouver. *G. macrodactylus* Edwards et Lucus, from Chili, is the same species.

I have nearly completed a revision of the genus *Gelasimus*, and perhaps it may not come amiss to state some of my facts in advance of the appearance of the completed paper. *G. maracoani* Latr. (*armatus* Smith), *heterocheles* Bosc. (*patlydactylus* Edw., *princeps* Smith), *vocator* Martens ex Herbst. (*vocans* Edw. *palustris* Edw. *pugnax*, *mordax et rapax* Smith, *brevifrons* Stm., *affinis* Streets), are found on both shores of our continent, and specimens of *vocator* and *pugillator* are in the museum of the Philadelphia Academy from Mauritius, and of *maracoani* from Natal. *G. coarctatus* was described from Odessa, by the elder Milne-Edwards, while his son reports it from New Caledonia. The Philadelphia Academy possess one of the original specimens which formerly belonged to Guerin-Meneville. No subsequent author (to my knowledge) has ever seen a specimen from Europe. Marcussen in his first paper on the Crustacea of the Black Sea[3] does not mention it, but I have not access to his subsequent paper nor that of Uljanin on the fauna of that locality. Heller in his Crustacea of Southern Europe, quotes it on the authority of Edwards. Now Guerin's specimens and Edwards' description and figure[4] agree well with specimens from the Philippines and Australia, and answer in every particular to the description by Adams and White[5] of *G. forcipatus* from Borneo. The name *coarctatus* must hence lapse into synonymy. I am inclined to consider the locality Odessa as erroneous. From these few facts, selected from

[1] Additions to the Carcinological Fauna of New Zealand. Trans. New Zealand Inst., 1879, pp. 392–397.

[2] l. c., pp. 401–402.

[3] Archiv für Naturgeschichte, XXXIII, pp. 358–363.

[4] Annales Sciences Naturelles, III, XVIII, 146, pl. III, Fig. 6.

[5] Voyage of the Samarang Crustacea, p. 50.

a large number in the writer's notes, it will be seen that our notions of the geographical distribution of marine forms must be considerably modified and that the number of known species is considerably less than the number of descriptions of supposed distinct forms would indicate. I find the fiddler crabs enumerated under nearly one hundred distinct names, while the number of species will not much exceed forty, and this confusion has proceeded partly from the idea that distinct localities must have distinct forms and partly from assuming that minute variable characters were of specific importance; and I would here say that my own work in both of these respects has not been altogether faultless, but I hope ere long to correct my sins of omission and commission.—*J. S. Kingsley.*

THE PSOROSPERMS FOUND IN APHREDODERUS SAYANUS.—Mr. W. P. Seal recently brought me a specimen of this curious little fish, which he had obtained near Woodbury, N. J. The specimen had interested him on account of the great number of large white cysts imbedded in its muscles just beneath the skin, causing the latter to swell outwards, producing an appearance of lumps on the body, as if diseased. When the little animal was held between the eye and light, the embedded cysts being opaque, made it easy to locate each one, and I have sketched this appearance in the accompanying outline (Fig. 1, A) of the fish with the cysts in place. There were about twenty of these cysts in all, which were found to be arranged as a rule in pairs on the opposite sides of the body of the fish.

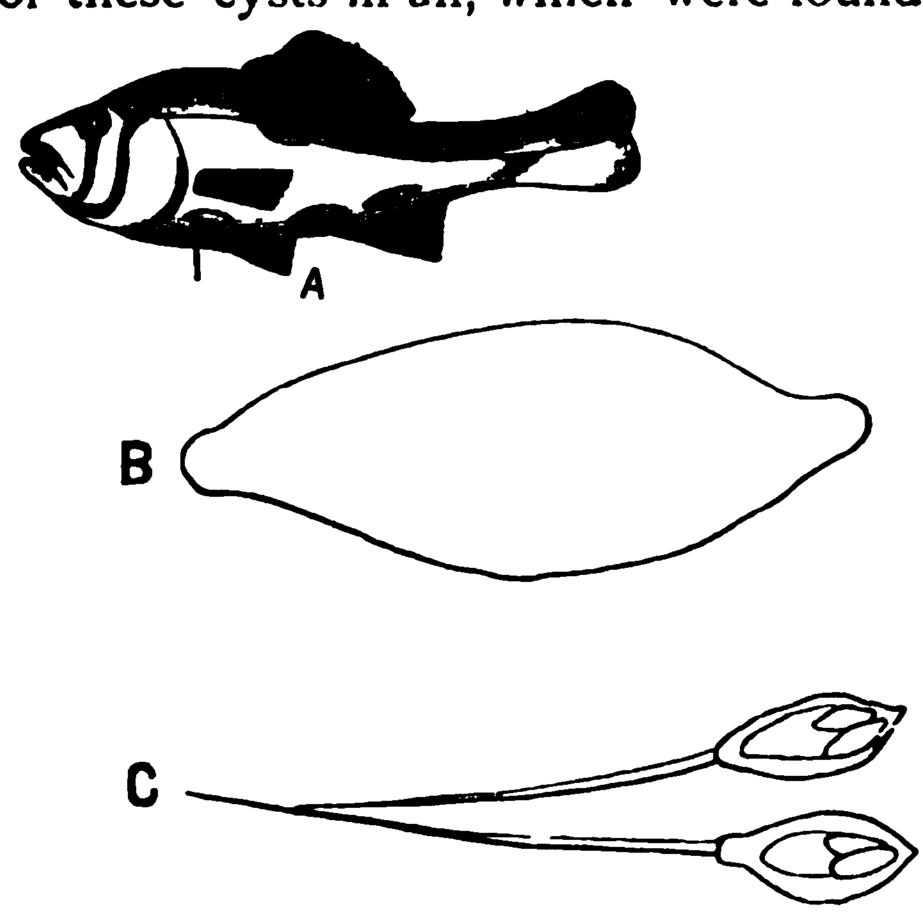

FIG. 1.—Psorosperms in the pirate perch. B, cyst much enlarged.

On cutting through the skin, the cysts were found to have a very thin membrane, which when ruptured, allowed a thick white creamy mass to escape. Upon examining this material with a power of 900 diameters it was found to be entirely composed of very minute ovoid bodies with a tail, as shown in Fig. 2, D: a pair of nucleated elongate bodies were enclosed and attached to the membranous body-wall of what appeared to be the head end. There were many thousands of these bodies in a single cyst, and were it not that the tail did not exhibit the slightest movement, they might have been regarded as spermatozoa. A very few were seen without a tail as in Fig. 2, C.

Fig. 2, B represents an optical section of the head end of one like that shown at D in profile, and shows the oblong attached internal bodies in an excentric position with reference to the enveloping membrane. Excessively minute round granules were found mixed in great abundance with the tailed forms.

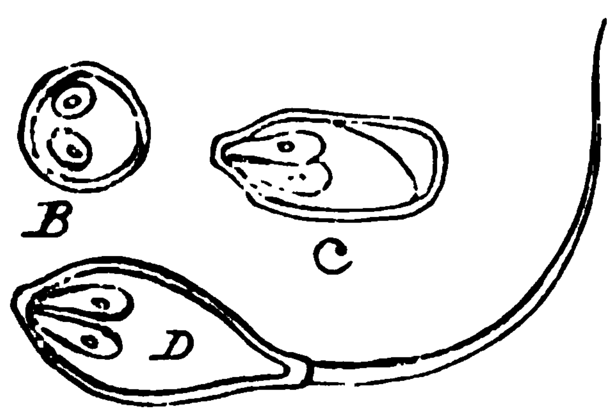

FIG. 2.—Psorosperms.

These are veritable psorosperms and are almost identical in form with those found by Müller in 1841, in European freshwater fishes. The above description is not different in any essential particular, from that given by Müller, and I only offer this account in order that it may induce others to look for similar parasites in other common vertebrates. Cobbold states that they are harmless if eaten with the flesh which contains them, stating that in eating of the heart of a healthy ox, which had furnished part of two meals, he himself must have consumed at least 18,000 of these parasites. They are supposed to be an embryonic stage of development of the Gregarines.

Psorosperms, have not, as far as I am aware, been recorded as being found in *Aphredoderus*, which is a characteristically American fish. There must have been half a million of these embryonic gregarines in the individual fish which I examined.—*John A. Ryder.*

STRUCTURE OF THE EYE OF LIMULUS.—The eyes of the horse-shoe or king crab are four in number; consisting of a pair of compound eyes situated on the side of the head, and a pair of small simple eyes on the front of the head. As described by A. Milne-Edwards and Owen, the optic nerves to these eyes are very long and slender. Those distributed to the larger compound eyes are very long, and close to each eye subdivide into an irregular plexus of fine nerves, a branch being, as we have found, distributed to each facet composing the compound eye. The structure of the eye is very unlike that of any other Arthropod eye. The cornea is simply a smooth convex portion of the integument, which is much thinner than the adjoining part of the chitinous skin. There are no facets, the cornea externally being structureless, simply laminated like the rest of the integument. In the internal side of the cornea are a series of solid chitinous conical bodies, separated from one another by a slight interspace and in form resembling so many minnie-rifle balls; the conical ends of these solid cones project free into the interior of the body, and are enveloped in a dense layer of black pigment. Within the base of these cones are secondary shallow cup-like bodies or shallow secondary cones. It is these primary cones which, seen through the smooth convex translucent cornea, give the appearance of a facetted surface to the external eye.

All the parts thus far described except the pigment layer, are moulted with the rest of the crust, and the large long slender cones can be easily seen by viewing a piece of the cast-off eye; the solid cones being seen projecting from the inner surface of the cast-off cornea.

The internal structure of the eye is very simple. *There are no cones and no rods*, but a branch of the optic nerve impinges directly upon the end of the solid chitinous cone, as determined by removing the layer of pigment with dilute potash, and treating the section with acetic acid and then staining with picro-carmine. So far as we can ascertain, no Arthropod eye is so simple as that of Limulus. Our observations have been based on a study of the structure of the lobster's eye from preparations of very great beauty and delicacy, kindly made for us by Norman N. Mason, Esq., of Providence, who has also made beautiful sections of the Limulus eye, after treating them in various ways. The question as to the nature of the solid cones we are not yet prepared to settle. Are they crystalline lens or only analogous organs? Can the horse-shoe crab distinguish objects? We doubt if its eyes enable it to more than distinguish between the light and darkness. Since the above remarks were put in type, we have seen Grenacher's great work on the eyes of Arthropoda. He regards the conical chitinous minnie-ball-like bodies as corneal lenses. He does not describe the simple eye, which is a close repetition of one of the corneal lenses of the compound eye of the same animal, except that the lens is shorter and with the end much more obtuse.—*A. S. Packard, Jr.*

Advent of Passer domesticus in North Carolina.—The following letter is published in the belief that it is desirable to preserve records of the spread of this bird in this country.—*Elliott Coues, Washington, D. C.*

Dallas, N. C., Nov. 30, 1879.

Dr. Elliott Coues.

Dear Sir:—Thinking that any information concerning the English sparrow would be appreciated, I take this liberty. On the 23d inst., I saw what I believed to be one of that species at this place, and on the 24th and 25th, I killed two. Both were males. Gaston county, of which Dallas is the county seat, borders on South Carolina, is in the Piedmont region, but still a good ways south, and I had supposed that we would never be invaded. The West and North I had supposed were the only parts of the country that would be cursed with them, but this looks as if they were coming South. They will find no nesting boxes here, however. Are they migratory?

Yours, &c., Paul B. Barringer, M. D.

The Structure of the Tracheæ and the "Peritracheal Circulation" in Insects.—Under this title M. Jules Macleod, of

Gand, has published a prize memoir of more than ordinary value. His conclusions are as follows: 1. The wall of the trachea comprises three layers: one external, probably connective; a middle chitin-forming, and an internal chitinous layer. 2. The spiral thread does not belong properly to the tubular tracheæ. 3. The spiral thread does not differ from the rest of the intima by its thickness alone; but especially in its functions. 4. The tubular tracheæ, and especially the intima of those organs, present numerous variations, even in a given group, like that of the winged insects, for example. 5. The chitin-forming tunic of the trachea is not formed by cells fused together, but it is on the contrary a true epithelium. 6. The middle tunic remains independent along the whole length of the trachea. 7. The peritracheal circulation is anatomically impossible. 8. In many larvæ, the intima presents besides the spiral thread, other parts, differing by their properties.

It will be remembered that Blanchard, and afterwards Agassiz, assumed that there was a circulation of blood between the trachea proper and its investing peritracheal membrane. Joly, and afterwards H. J. Clark of this country, maintained that this was anatomically impossible, and Macleod by experiments and dissections shows that such must be the case.

VITALITY OF HELIX ASPERA.—Almost incredible statements are found in the books concerning the vitality of snails. I must add another. August 24th, 1878, I ascended an old castle, or square tower, near Queenstown, Ireland, and found between the stones a number of the common garden snail of Europe, *Helix aspera.* I secured three specimens, and having wrapped them in paper, put them in my trunk. On my arrival home, October 28, on looking for my treasures, I found one was crushed. The other two I dipped in water a few seconds, then put them in the fernery, and was delighted to see them crawl about. I could not get them to feed. One died in the following May, having been in confinement nine months. The other died in November, 1879, having lived thirteen months without food.—*S. Lockwood, Freehold, N. J.*

ZOÖLOGICAL NEWS.—In *Forest and Stream* for Jan. 29, Henry Youle Hind states that the salmon on the Labrador and Newfoundland coast spawn in the spring as well as in the autumn, *i. e.*, that some spawn in the autumn and some in the spring.——A blind Asellus-like Isopod Crustacean has been discovered by Prof. Forel, at great depths, in Lake Leman; the eyes are rudimentary, while the general color of the animal is white.——Mr. Darwin notices, in *Nature*, the fertility of hybrids from the common and Chinese goose, and shows that the fertility is complete.——M. H. W. Bates states that certain species of Longicorn beetles mimic Lampyrid beetles "with great exactness, the light-

giving segments of the latter being perfectly represented in the Longicorns, although destitute of phosphorescent power."——The Report of the Commissioners of Fisheries of California for 1878 and '79, contains numerous and valuable notes on the food fishes of San Francisco by W. N. Lockington.——The Journal of the Royal Microscopical Society reports the discovery of an Otocyst-like organ in the antennæ of flies (Syrphus, etc.). There seems little doubt but that many Diptera (Muscidæ and Tabanidæ excepted) have these minute ears situated in the third joint of their antennæ. Mayer, however, questions whether these organs, of which he claims to have found fifty in the antennæ of *Musca vomitoria*, are ears, though he regards them as organs of some sense. Dr. H. Krauss finds an otocyst in the larva and imago of Tabanus, the horse-fly.——Dr. H. Burmeister discovers that the fine longitudinal lines or striæ of butterfly scales belong to the upper membrane of the scale, and that they are due to filaments which are elevated on the inner side of the upper membrane. These views are in opposition to those of Beck, and may be incorrect.—— Mr. James Ward has recently been performing some interesting experiments on the nervous system of the cray-fish.[1] He arrives at the conclusions from cutting the nervous cords at various positions, that there is no decussation of the longitudinal nerve fibres unless within the supra-œsophageal ganglion; that the supra-œsophageal ganglion is the highest center of nervous activity, though not identical with the cerebral lobes of vertebrates, and that the infra-œsophageal ganglion is the great center for the co-ordination of the movements of the body. ——The "Arbeiten" of the Zoölogical Institute of Vienna, Vol. II, Part II, 1879, contains a revision of the known genera and species of the Platyscellidæ (Crustacea Amphipoda), and a description of a new Siphonophore from the Mediterranean by Carl Claus. ——Mr. Gibbes[2] has been making some investigations regarding the structure of the spermatozoa, and finds that the head, from its reaction with coloring agents, possesses a different chemical structure from the rest of the organism. A filament was found to arise at the base of the head, in all the animals examined, which was united to the "tail" of the spermatozoön by a delicate membrane, and Mr. Gibbes maintains that the head is enclosed in a sheath continuous with this membrane, and that the motive power lies in the filament and the membrane attaching it to the tail.

[1] Some notes on the Physiology of the Nervous System of the Crayfish. Journal of Physiology, Vol. II, pp. 214–227.

[2] On the Structure of the Vertebrate Spermatozoön, by Heneage Gibbes. Quar. Jour. Micro. Sci., Oct., 1879, pp. 487–491, pl. XXIV.

ANTHROPOLOGY.[1]

OBER'S CARRIBEES.—Lee & Shepard, of Boston, have just issued a work entitled "Camps in the Carribees," by Mr. Frederick A. Ober, who undertook a scientific exploration of the Lesser Antilles in 1876. The most of the volume is occupied with a racy account of the naturalist's experience in those islands while collecting specimens in zoölogy. Chapters VI, VII and XIII, however, come under our immediate topic. In two of the smaller islands, Dominica and Saint Vincent, are the only remnants of that powerful race which struck terror into the hearts of Columbus and his followers. Humboldt relates that the Caribs of South America called themselves Carina, Calina, Callinago, Caribi, and that the name Carib is derived from Calina and Califoona; the latter word being the ancient name of their people given to Mr. Ober by the Caribs of St. Vincent and Dominica. This name the author seeks to connect with Shakespere's Caliban, and Robinson Crusoe's "Man Friday." Their ancient savage manners have wonderfully changed, for they are now gentle, hospitable, and kind to their women. They are naturally much lighter than the typical Indian, which has given them the title of "Yellow Indians." In Dominica there are but twenty families of pure Caribs; in Saint Vincent less than six. In the latter island there is an interesting people, called "Black Caribs," formed by the intermarriage of the natives with negroes. Mr. Ober confirms the statement of a difference between the language of the men and that of the women. They have, besides, a certain form of speech which they use among themselves in war-councils. The author inclines to the view that the Caribs were the race who made the beautiful stone implements, collars, mammiform stones, masks, &c., found throughout these islands. In the National Museum is a collection of implements brought by Mr. Ober from Saint Vincent. The volume before us will prove interesting not only to the ethnologist but to the ornithologist, as the appendix contains a list of all birds collected.

MOUND BUILDERS.—The second number of Vol. II, of the *American Antiquarian* contains the following papers: The Mound Builders; Explorations by the Muscatine Academy of Sciences, by J. E. Stevenson; Alaska and its Inhabitants, by Rev. Shelton Jackson; Antiquity of the Tobacco Pipe in Europe. Part II. Switzerland, by E. A. Barber; Fort Wayne (old Fort Miami) and the Route from the Maumee to the Wabash, by R. S. Robertson; How the Rabbit Killed the (Male) Winter, an Omaha Fable, by J. O. Dorsey; The Delaware Indians in Ohio, by S. D. Peet; The Silent Races, by L. J. Dupré; Sacrificial Mounds in Illinois and Ohio.

The paper of Mr. Stevenson upon the explorations of the Muscatine Academy is a very important contribution to mound-literature. "From an imaginary point near Drury's Landing, a few

[1]Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

miles above and east of Muscatine to another like point, and down the river, near Toolesboro and New Boston, distant from the first point twenty miles, the bluffs (once the Mississippi shore line) recede from each other about eight miles, and upon all the highest points are found groups of mounds, numbering from two to one hundred or more, varying in base diameter from fifteen to one hundred and fifty feet, and from two to fifteen feet in height. In all there cannot be far from two thousand five hundred mounds." Mr. Stevenson enters into a calculation of the time required for their erection. Among civilized peoples, only the head of the family is engaged in active industry; but it is quite possible that men, women and children entered with enthusiasm into this national work. The papers of Messrs. Jackson, Barber, Robinson and Dorsey, are all of permanent ethnological value. Mr. Peet will publish also a quarterly, entitled *The Oriental Journal.*

Mr. F. W. Putnam communicated the following note to the Boston Society of Natural History, October 15, 1879, on the occurrence of chambered barrows in America:

"The chambered mounds are situated in the eastern part of Clay Co., Missouri, and form a large group on both sides of the Missouri river. The chambers are, in the three opened by Mr. Curtiss, about eight feet square, and from four and a half to five feet high, each chamber having a passage-way several feet in length and two in width, leading from the southern side, and opening on the edge of the mound formed by covering the chamber and passage-way with earth. The walls of the chambered passages were about two feet thick, vertical, and well made of stones, which were evenly laid, without clay or mortar of any kind. The top of one of the chambers had a covering of large flat rocks, but the others seem to have been closed over with wood. The chambers were filled with clay which had been burnt, and appeared as if it had fallen in from above. The inside walls of the chambers also showed signs of fire. Under the burnt clay, in each chamber, were found the remains of several human skeletons, all of which had been burnt to such an extent as to leave but small fragments of the bones, which were mixed with the ashes and charcoal. Mr. Curtiss thought that in one chamber he found the remains of five skeletons and in another thirteen. With these skeletons there were a few flint implements and minute fragments of vessels of clay.

"A large mound near the chambered mounds was also opened, but in this no chambers were found. Neither had the bodies been burnt. This mound proved remarkably rich in large flint implements and also contained well-made pottery and a peculiar 'gorget' of red stone. The connection of the people who placed the ashes of their dead in the stone chambers with those who buried their dead in the earth mounds is of course yet to be determined."

ANTHROPOLOGICAL NEWS.—The question is frequently asked, How does anthropology fare in the catastrophe which destroyed the three surveys of Hayden, Wheeler and Powell? It is the purpose of this brief note to answer this question. In the same bill in which provision was made for the establishment of the new survey under Clarence King, an appropriation was granted for continuing the ethnographic work, and this resulted in the organization of what is known as the Bureau of Ethnology, and Major J. W. Powell was put in command of the corps. This Bureau is now engaged with the aid of skilled collaborators in the following work: 1. Preparing a history of Indian affairs, including an atlas of treaty cessions, exhibiting by graphic signs and descriptive text, the manner and time of the yielding up of our territory by the aborigines. 2. Carrying on an exhaustive investigation concerning the languages of the North American Indians, including a series of grammars and dictionaries and a bibliography. At present it is found convenient to group them into the following linguistic stocks: Adaize, Achomawi, Aleut, Algonkin, Alikwa (Yurok), Ara (Karok), Atakapa, Atimoke (Timucua), Billekula, Bribri, Caddo, Cheroki, Chetimacha, Chiapanec, Chimariko, Chimseyan, Chinuk, Coahuiltec, Coiba (Cueva), Dakota (including Catawba), Galibi, Haida, Hailtsuk, Huave (Wabi), Inuit, Iroquois, Kalapuya, Kera Pueblo, Kaiowa, Kusa, Kutené, Maidu, Maklaks (Klamath), Maskoki, Maya (Mixe), Mutsun, Nahuatl, Numa, Nutka (or Bowatchat), Otomi, Pani, Pirinda, Pomo, Rio Grande Pueblo, Sahaptin, Sasti, Sayuskla, Selish, Seri, Takilma (Kalapuya), Tarasco, Telame (including Santa Barbara and San Antonio), Terraba, Thlinkit, Tinné, Tonkawe, Ulua (Maya), Washo, Wayiletpu, Wichita, Wintum, Wishosk, Xicague (Nicaragua), Yakona, Yokuts, Yaki, Yuma, Yutchi, Zapotec, Zuñi. 3. A collection of a complete synonymy of North American Indians as material for an encyclopedia or classical dictionary of every tribe known to have lived on our continent. 4. An investigation into the sign language, by Colonel Garrick Mallery. 5. An account of savage mythology or philosphy, under the special direction of Major Powell. 6. The study of the arts and industries of all our tribes. During the past summer a party consisting of Mr. James Stevenson, Mr. Frank Cushing and Mr. J. Hillers were dispatched to the Pueblos, with instructions to leave no object, sketch, or custom that would be valuable to the ethnologist. Mr. Stevenson had charge of the collection, Mr. Hillers of the photography, and Mr. Cushing of the ceremonial part of the work. The first two gentlemen have already returned laden with four car loads of the finest specimens of aboriginal art ever brought together. Mr. Cushing, who has succeeded in ingratiating himself with the Pueblo people, will remain over the winter. The enumeration of a few of the objects in this superb collection will give some idea of its rare value. From Zuñi: pottery, whole and

in fragments, together with clay, and all the implements used in pottery manufacture and decoration, leather dye, dried peaches, bread used in dance, medicine sticks, pottery drums, war shields, carved chairs, snow shovels, bread paddles, dried meat, bows and arrows, toys, moccasins, stone molds, mallets, quoits, rattles, herb tea. From the Moquis:—dresses, looms, sheets, belts, blankets, stockings, dance-ornaments, pouches, sashes, tassels, rabbit-skin robes, saddle bags, boomerangs, stone images, arrows and bows, with all the implements for making them, corn-mills, virgin's head dress, cradles, hair curlers, forceps, lariats, moccasins, dance-ornaments, wrist guards, medicine boxes, balls for play, vermin killers, gambling cups, mush sticks, snares, agricultural implements, water bottles, paint rock, baskets for every purpose. Scattered through the valley of the Rio Grande are nineteen Pueblo villages, and it is designed to make characteristic collections at every one. Mr. Hiller's collection of photographs includes views of the interior and exterior of these Pueblos from every accessible point of view, and of the natives of various ranks in their characteristic attire. The most interesting of his pictures is a group of albinos, the skin and hair being quite white, who intermarry with the other members of the tribe and are very highly esteemed.

Mr. Wm. J. Rhees, chief clerk of the Smithsonian Institution, has edited a pamphlet of 96 pages, entitled "Visitor's Guide to the Smithsonian Institution and National Museum." The latter portion, from page 63 to the end, is occupied with a brief description of Anthropological Hall, under the direction of Dr. Charles Rau. Although the publication is provisional, it is exceedingly timely, and will assist the visitor to acquire a good general knowledge of our national collection.

From London *Nature* we extract the following list of short articles: December 4th, The Turkomans, by H. H. Keane, a review of a paper by Professor Arminius Vambery, before Anthropological Institute of London; Finnic ethnology, a review by A. H. Keane, of "Finnish Crania," by Gustav Retzius, of Stockholm, in December 25th. Dr. Retzius adopts the view that the Finns are amongst the most recent arrivals from Asia; Mr. J. C. Galton reviews at length in January 1 and January 8, Maclay's "Observations upon the Papuans of the Malay coast of New Guinea," giving an account of many most interesting customs; January 5, a review of the following work: Catalogue of specimens illustrating the osteology and dentition of vertebrated animals, recent and extinct, contained in the museum of the Royal College of Surgeons, of England, by William Henry Flower, conservator of the museum. Part I, *Man.* (London: David Bogue, 1879.)

The *Academy* for January 3, announces that Dr. Robert Hartmann is the author of a monograph, entitled "Die Nigritier, eine

anthropologisch-ethnologische Monographie," published as a supplement of five hundred pages to *Zeitschrift für ethnologie*, Berlin.

The October number of the *Revue d'Anthropologie* contains the following original papers and reviews: Notes sur la fécondité des mulatres du Sénégal, by M. Berenger-Feraud, 12 pp.; de la notion de la Race en Anthropologie, by M. Paul Topinard, 72 pp.; Note sur le Développement du Cerveau considéré dans ses Rapports avec le Crâne, by M. Ch. Féré, 14 pp.; Une négresse blanche, by Dr. Smester, 7 pp. La Mythologie Comparée, of M. Girard de Rialle is reviewed in a critique of eight pages, by M. André Lefèvre. The chapter entitled " Revue Préhistorique, by M. E. Callamand, embraces a review of Greenwell's 'British Barrows,' " eleven pages, and a résumé of the prehistoric portion of Bulletin de la Société d'Anthropologie, 4 pp. The book review, by M. Zaborowski, is a critique of 8 pp. on Chudzinski's "Anatomie comparée des circonvolutions cérébrales." Under the Revue des Journaux are reviews upon: Etude sur les crânes boughis et dyaks du Muséum d'histoire naturelle, by Dr. Montano; Anomalie symétrique héréditaire des deux mains, by Dr. Bœchat de Fribourg, in *Bull. Congr. medic. intern.* de Genéve, 1878; Aperçu général de l'hérédité et de ses lois, by Dr. Marc Lorin, Thèse inaugurale de la Faculté de medecine, Paris, 1878; Annales de démographie internationale, recueil trimestriel publié sous la direction du Dr. Arthur Chervin, Deuxieme année, Paris, 1878; Lectures on the Indigenous races of the Pacific Ocean, by William H. Flower; Anthropology of the county of Gloucester, by Dr. John Beddoe, in *Trans. Glouc. Arch. Soc.*, Bristol, 1878; Essay upon the anthropology of Southern Tyrol, based upon the examination of skulls discovered at Saint Pierre, near Meran, by M. Rabl-Ruckhard, *Berlin Gesellsch. f. Anth.*, &c., Feb. 16, 1878. The number closes with brief extracts, a short résumé of the various anthropological congresses during the year, and a bibliographical bulletin of five pages. The most valuable contribution to the number is the paper of M. Topinard upon the idea of "race" in anthropology, and demands more space for a review than we can give it here.

Prof. Friedrich Müller contributes to *Das Ausland*, No. 10, a short article upon the language of animals.

The *Verhandlungen der Berliner Gesellschaft für Anthropologie, Ethnologie, und Urgeschichte* from January-February of the current year, give us a digest of the proceedings of that celebrated society. In turning over the leaves we find quite extended abstracts of the following communications: Session of Jan 11. Skull from the Bone-Cave of Gorenice, near Ojcow, Poland, by Ferd. Römer, in Breslau, with Table IV; Upon the stone implements of Japan, and upon various antiquities in the collection of the German Society for the study of Eastern Asia, by Hr. v. Brandt; Results of his measurements of school children, by Pro-

fessor Lucæ; Upon the language of the Australians, by Hr. Steinthal. Session of Jan. 18: "Face-urn" from a stone-cyst grave in Gabolin (Kreis culm, West Prussia); Fung Schui, or Chinese "Geomanty;" Black pottery in India and in Turkey, by Hr. Jagor; Upon the cemetery of Giebichenstein, near Halle, Hr. Credner. Session of Feb. 15: The canicars of Southern India, by Hr. Jagor.

The following titles from various sources may be of service to some of our readers: The oldest art in the world, by W. J. Loftie, (*Macmillan's Mag.*) *Electic Mag.*, Dec., 4 pp.; Beasts, Birds, and Insects in Irish Folk-Lore, by Letitia McClintock, *Belgravia*, Nov., 8 pp.; The Ancient Remains at Bounarbashi, by W. Simpson, *London Academy*, Nov. 1; Cinderella, by W. R. S. Ralston, *Nineteenth Century*, Nov., 22 pp.; The study of Cuneiform Archæology, by Rev. B. W. Saville, *Clergyman's Magazine*, Nov., 16 pp.; The Deluge: Its traditions in Ancient Nations, by F. Lenormant, *Contemporary Rev.*, Nov.; The Supreme God in the Indo-European Mythology, by J. Darmsteter, *Contemporary Rev.*, *Living Age*, Oct. 25, 10 pp.; The Hittites in Asia Minor, *London Academy*, Nov. 1; Monumental Inscriptions in all parts of the world, *Calcutta Rev.*, July; Pliocene Man, by Dr. C. C. Abbott, *Kansas City Review*, Nov.; Pottery in Prehistoric Times, by L. Jewitt, *Illustr. Art Journ.*, Nov., 3 pp; Preservation of Ancient Ruins and Monuments, *Chamber's Journal*, Nov.; Les Temps oublies, by E. Littré, *Philosophie Positive Revue*, Dec., 8 pp.; Fetish or Rag Bushes in Madagascar, *Saturday Mag.*, Nov. 22; The Music of Hindustan, by B. S. P. Ghosha, *Calcutta Rev.*, July; Institutions et Mœurs Annamites, by T. V. Ky, *Philosophie Positive Revue*, Dec., 12 pp.; Language and the Egyptian Language, by Dr. C. Abel, *New Englander*, Nov., 15 pp.; Des Origines et de l'Evolution du Droit economique, by H. Denis, *Philosophie Positive Revue*, Dec., 12 pp.; The Bohemians and Slovaks, *Westminster Rev.*, Oct., 30 pp.; Cabul and its People, *Saturday Mag.*, Nov. 8, 2 pp.

The following are recent articles of interest:

CHARENCY, M. DE—Ages Cosmiques d'apres la Mythologie mexicaine, I. *Annales de Philosophie Chretienne*, Nov., 15 pp.

BUDGE, A.—Assyrian Incantations to Fire and Water. *Tr. Soc. Biblical Archæology*, VI, 2.

BOSCAWEN, W.—Notes on Assyrian Religion and Mythology. *Tr. Soc. Biblical Archæology*, VI, 2.

HOUGHTON, W.—Hieroglyphic or picture origin of the characters of the Assyrian Syllabary. *Tr. Soc. Biblical Archæology*, VI, 2.

MCCLINTOCK, LETITIA—Beasts, Birds and Insects in Irish Folk-lore. *Eclectic Mag.*, Jan., from *Belgravia*.

COX, REV. G. W.—Homeric Mythology and Religion. A Reply to Mr. Gladstone. *Frazer's Mag.*, Dec.

Forms of Salutations. *Eclectic Mag.*, Jan.

MENON, P. S.—On the Coast of Madagascar. *Madras J. of Literature*, I.

ROGERS, E. T.—Dialects of Arabic. *J. of Roy. Asiatic Soc.*, Aug.

VINSON, J.—Esquisse Grammaticale de la Langue de God. *Rev. Linguistique*, Oct.

ASTON, W. G.—A Comparative study of the Javanese and Corean Languages. *J. of Roy. Asiatic Soc.*, Aug.

Grammaire Samoane. *Rev. Linguistique*, Oct.

OPPERT, G.—On the Ancient Commerce of India. *Madras J. of Literature*, I.

GEOLOGY AND PALÆONTOLOGY.

FOSSIL CRAWFISH FROM THE TERTIARIES OF WYOMING.—Two specimens of fossil crawfish quite well preserved have been kindly loaned us for description by Professor Leidy, who received them from the fish beds of the western border of Wyoming, through Dr. J. Van A. Carter, of Evanston, Wyoming. Of the two specimens, the smaller presents a dorsal, and the larger a lateral view, both being slightly distorted by pressure; the length of the smaller from the tip of the rostrum to the end of the telson is 38 mm., and of the larger 53 mm. They do not differ generically from existing species of Cambarus, though with some resemblances to Astacus, but as the gills are not represented it is not possible to say to which of these two genera the species belongs; still the weight of characters ally it nearest to *Cambarus affinis*, as seen in the long narrow pointed rostrum, and the form of the chelæ and the second antennal scales. These scales are also much as in *C. obesus* var. *latimanus* and *bartonii*, but rather narrower, the lateral terminal spine being long, slender, acute. The flagellum of the second antennæ are of the usual size, extending to the terminal fourth of the abdomen. The distal end of the scape of the first antennæ reach to near the end of the last joint of the scape of the first pair, the species in this respect being more like Cambarus than Astacus. The carapace is of the proportions of living species of Cambarus. The first pair of legs are rather shorter and stouter than in our living crawfishes, and the chelæ are rather shorter, while the surface of the carapace and legs is much more coarsely tuberculated than in our Cambari, and in this respect resembles large specimens of *Astacus fluviatilis* of Europe, though the tubercles are larger.

The abdomen is of the usual proportions, but the surface is more coarsely tubercled; the telson and broad rami of the last pair of feet are spined as in living species of Cambarus. It is interesting to observe that this species is nearest related to *Cambarus affinis*, which as observed to me by Mr. P. R. Uhler, who kindly gave me some species for comparison, is the more generalized American species of the genus, and probably the oldest one. It would be interesting to know whether this fossil form is actually a Cambarus or an Astacus, and to ascertain which of these two genera, now restricted, the latter to the Pacific slope of the Sierra Nevada, the former to the Central and Eastern zoö-geographical provinces, was the first to obtain a foothold on our continent. There is a probability that the present fossil form is a member

of the American genus Cambarus. The species may be called, therefore, *Cambarus primævus*.—*A. S. Packard, Jr.*

ON THE SAUROPTERYGIA OF BOULOGNE-SUR-MER.—Dr. H. E. Sauvage has recently published an interesting memoir on the above subject, including in it many general remarks on the affinities and contents of the order *Sauropterygia*. He uses the results of the latest investigations on the subject, referring especially to those of Seeley. He describes several species heretofore very little known, and adds a number of new ones to Scientific Literature. Those which Dr. Sauvage finds in the Upper Jurassic beds of the Boulonnais are: *Pliosaurus gamma* Ow.; *P. grandis* Ow.; *P. suprajurensis* Sauv.; *Polytychodon archiaci* E. E. Desl.; *Plesiosaurus carinatus* Ow.; *P. phillipsi* Sauvg.; *P. morinicus* Sauvg.; *P. infraplanus* Phil.; *P. plicatus* Phil.; *P. ellipsospondylus* Ow.; *Colymbosaurus dutertrei* Sauvg.; *Muræuosaurus manseli* Hulke; *Polycotylus suprajurensis* Sauvg.

A NEW HIPPIDIUM.—A species apparently of this genus of horses has been discovered by Prof. Thomas Condon in the Loup Fork beds of Cottonwood creek, Oregon. It is represented as yet by superior molar teeth only, which are larger than those of any of extinct American horses, excepting the *Equus excelsus*, about equaling those of *Hippidium neogæum* Lund. The crowns of these teeth are very long and slightly curved, and the roots are short. The internal columns are relatively small, are subequal in size, and are flattened in outline. A peculiarity of the species is seen in the great transverse width of the lakes which, at the middle, is equal to the anteroposterior diameter. The crescents, and especially the inner ones, are correspondingly narrow. The enamel borders are simple, there being only a few notches on the adjacent faces of the lakes. One loop projects from the inner enamel border, almost reaching the anterior inner column. Cement abundant. Diameters of second premolar: anteroposterior, m. .035; transverse behind .021; height of crown .035. Diameters of a superior molar: anteroposterior, .027; transverse, do., including external ridge, .027; longitudinal externally, .045. The species of the genus heretofore described from the United States (*H. pernix* and *H. robustus*), are represented as having teeth with short crowns and long fangs, and of materially smaller size. The species may be called *H. spectans*. The teeth are about the size of those of the quagga.—*E. D. Cope.*

GEOGRAPHY AND TRAVELS.[1]

UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES. WORK OF 1877-8, PRIMARY TRIANGULATION AND YELLOWSTONE PARK MAPS.—Among the posthumous works of Dr. F. V. Hayden's Survey of the Territories, there have recently

[1] Edited by ELLIS H. YARNALL, Philadelphia.

appeared a series of maps, comprising most of the topographical work of the last two years, 1877 and 1878. This series comprises a sketch of the primary triangulation, and a drainage map, each covering the whole area surveyed, on a scale of eight miles to an inch, a detailed map of the Yellowstone National Park, on a scale of two miles to an inch, and three detailed atlas sheets, on a scale of four miles to an inch. The last three sheets were noticed in the number of the NATURALIST for January.

The triangulation sheet shows the scheme of the primary triangulation, the stations, the sight lines, the closed and open triangles, the details of the expansions from the bases, and the astronomical connections.

The base lines were two in number, one near Fort Steele, on the Union Pacific railroad, Wyoming, the other in the valley of Bear River, near the village of Georgetown, Idaho. Each was between five and six miles in length, about two miles of which appear to have been measured directly, while the balance was ranged out by small, well proportioned triangles. The expansions were by means of closed triangles, and, apparently were well executed. The astronomical connections were ample, consisting of stations at Sherman and Fort Steele in Wyoming, Salt Lake City and Ogden in Utah. These points were located by the Coast Survey and by Lieut. Wheeler of the Engineer Corps. The scheme is well planned, most of the triangles being well proportioned and the only failures are unquestionably due to the incompleteness of the work, owing to the abrupt discontinuance of the survey.

Since the discovery of the wonders of the Yellowstone country, in 1870, this region has been a favorite field of exploration. Expedition after expedition has traversed it, each following much the same routes as its predecessors, and, after the first, adding but little to the sum of human knowledge regarding this strange fire-ridden region.

The explorations in this region, of the survey under Dr. F. V. Hayden, in 1871 and 1872, were singularly prolific of facts, geological, physical and geographical, and little that was new was evolved from numerous expeditions that followed. The big nuggets had been taken, and nothing but a careful, scientific, reworking of the tailings would extract from them the wealth of fine gold which they still held.

In 1878, Dr. Hayden's survey reached this region in the prosecution of its system of surveys. Its work had, years previously, passed from the reconnoissance stage to that of systematic surveys on a scale and of a degree of accuracy commensurate with the needs of the country.

In that year, a party was directed to make a detailed survey of the Yellowstone Park, its geography, geology and volcanic phenomena.

A part of the results of this season's work is now before the

world, in the form of a map of the Yellowstone Park on a scale of two miles to an inch, a scale sufficiently large to show all details necessary to the geologist, or the traveler. The topography is represented by contour lines, at approximate intervals of one hundred feet. This map, as well as the others published by this survey, are admirable illustrations of relief-effect by means of contours; and they not only express the relief, but the absolute and relative elevations.

From a study of this map, we find that the greater part of the surface of the Park consists of high rolling plateaus, broken by stream beds, cliffs and cañons. Several small groups of mountains diversify the surface, among them the Red mountains, in the southern part, rising two thousand feet above the general level, or more than ten thousand feet above the sea—and the Washburn group, near the middle of the Park. This group has the form of a horseshoe, opening towards the east. The eastern border of the Park is occupied by a high, rugged range, to which has long attached the name of Yellowstone Range. Index peak; the highest measured peak in this range, exceeds 11,700 feet in height. In the north-western corner of the Park is the southern extremity of the Gallatin range, culminating in Electric Peak, a magnificent summit, 11,155 feet above the sea, which overlooks almost the whole Park.

The mean elevation of this reservation appears to be not far from 8000 feet, an elevation so great in this latitude as to presuppose an almost arctic climate. The lowest point within its limits is at the mouth of Gardiner's river, on the Yellowstone, which is 5360 feet.

Marked features of the reservation are the low, indefinite divides and the abundance of lakes and marshes. In several cases we note marshes extending across divides and making "two ocean rivers," phenomena by no means as uncommon as are popularly supposed. The lakes, principal among which are Yellowstone, Shoshone, Lewis and Heart, cover nearly 200 square miles out of the total area of the park, which is estimated at 3312 square miles.

Many newly discovered groups of hot springs and geysers appear, for the first time, on this map, among which should be mentioned the large and fine groups near the head of Gibbon's fork of the Firehole, the discovery of which has been previously noticed.

The engraving of these maps, by Bien, of New York, is one of the best specimens of his very excellent work.

MICROSCOPY.[1]

HINTS ON THE PRESERVATION OF LIVING OBJECTS, AND THEIR EXAMINATION UNDER THE MICROSCOPE.—I will now give a short summary of the most useful apparatus for the examination of liv-

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

ing objects. The simple glass slip, three inches by 1 inch, or better, a ledged stage-plate three inches by one and a half inches, with narrow strip of glass cemented along one edge. One of these, with cover-glass, is often all the apparatus necessary to use with small infusoria and free-swimming rotifers, and is also occasionally available with a little management for larger objects, either free or attached. Manipulation with these I cannot better describe than in the words of Judge Bedwell in his description of what I call Bedwell's rotifer-trap.

"Take a plane glass slide, on it drop one or more of the rotifers in a drop of water, about half an inch in diameter, and draw off the surplus water if any, carefully with the empty pipette; then fray out a very, very small portion of cotton wool (I always use a watchmaker's glass in the eye to do all such operations) until it is much extended, and spread out and lay this on the drop. Upon that lay the thin microscopic glass, the thinner the better, and then set up the capillary attraction by gently touching it with a needle. Draw off any superfluous water from the edges with the pocket-handkerchief, and you will have a little wilderness of wool in in which the rotifer is restrained in its movements, protected from pressure, and within reach of very high powers. The amount of wool depends on the size of the rotifer. Hydatina requires more depth than Rhinops. The same plan answers equally well for all roving animals. The Goduridæ in particular, when placed in deep glass cells, are easily seen by this apparatus, and it saves many a weary and vexatious five minutes with the compressorium, which even at the best, requires with living animals extraordinary patience. The rotifers are easily found and secured with the pipette and a watchmaker's glass in the eye after a very little practice. Mr. Bolton's studio is of the greatest value to naturalists, and cannot be too well known, for to those who have not time to look for specimens it is a great privilege to be able to purchase them."

Another simple apparatus I call the Wills' compressorium. Most forms of compressorium are useless—all are expensive. Those who try the following will be surprised at the efficiency of the apparatus. Two pieces of thin glass are cemented on to a glass slip in the shape of the letter L, but with the two strokes of the letter about equal in length, and another thinner and longer one is fixed longitudinally, thus L——. The L serves to retain in position a square slip of cover glass placed, of course, not on the L, but inside it; the horizontal piece, which should be ground to a bevel on its top edge before fixing it, serves to carry a fine needle, the point of which is inserted beneath the edge of the cover glass. This point being tapered, it is easy to increase or diminish the thickness of a film of water carried between the cover and the slip by pushing the needle further in or out, and so to form a cheap and effective compressorium.—*T. Bolton in English Mechanic.*

METHOD OF SEPARATING ORGANISMS FROM WATER.—In order to reduce the quantity of water containing infusoria, obtained by means of a collecting bottle or otherwise, an easy and effective method is to allow the liquid to stand in a bowl until it has settled, and then take up the water by means of a sponge placed in a pouch made of fine silk. If the water be allowed to soak into the sponge very gradually and a slight pressure be given before removing it from the bowl so as to wash away any adherent particles, even the finer forms of animalculæ diffused through a pint of water may be left in great abundance in a quantity of water not larger than a tablespoonful.—*M. A. Veeder.*

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SCIENTIFIC NEWS.

— One of the best and most successful fish culturists and practical ichthyologists in America has passed away. James W. Milner was born in Kingston, Ontario, January 11, 1841; he came to Chicago when about five years old, and he grew to manhood there, showing even as a child great, almost excessive devotion to study, the effects of which impaired his physical condition on more than one occasion.

He left the Northwestern University, before graduating, to take a place as a private soldier in the 1st Illinois Light Artillery. During his military service, which lasted until 1864, he exhibited an enthusiastic patriotism, courage and endurance, with a kindly interest in the comfort and welfare of those about him which made him a universal favorite. He passed through many of the severest battles of the war and volunteered at Vicksburg for the rescue of the wounded after the disastrous repulse of the "forlorn hope." Doubtless the privations which he endured somewhat undermined his constitution, and he took to farming, under the persuasion of his father, in hope of recovering in this way some of his lost vigor.

About 1870 his work in the direction of natural history led to a correspondence with Prof. S. F. Baird, and afterwards to his appointment as Deputy U. S. Fish Commissioner, which he retained until his death. Among his associates at the Smithsonian Institution, there was a general appreciation of his abilities as an observer and his qualities as a man. His chief interest and field of work lay in the culture, hatching and transportation of various fishes and invertebrates for economical purposes, which necessitated a very thorough study of their habits and conditions in a state of nature.

Among the works published by him the most noteworthy articles are those relating to the fishes of the great lakes, especially the whitefish, and his study of the graylings. He was naturally modest and given to underrating the value of his own work and hence was not easily persuaded to publish his studies.

history of fish culture and its practical workings he was doubtless better informed than any one else in this country at the time of his death. His enthusiastic and successful attempt at the fertilization and hatching of the eggs of the cod (never before attempted) kept him during an inclement season at Gloucester, Mass., under circumstances of great exposure. The disease of which he died was then first developed, though its seeds had doubtless long been latent in his system. A winter in Florida, a summer in Colorado, both came too late for his recovery to be even hoped for, and returning to his Illinois home (at Waukegan) he passed away in the midst of his family on the 6th of January, 1880. He left a wife and two children. Not only these bereaved ones will feel his loss. Those who knew him realize that a warm friend, a man of truth, integrity, modesty and sterling worth has been taken away, and that the pen of a careful, conscientious and intelligent observer and student has been laid down forever.—*W. H. Dall.*

— The collection of the late Dr. Asa Fitch comprised one hundred and six heavy cork-lined boxes (the cartons liégés of Deyrolle, 26 × 19½ c. m.), nearly all of double depth, and with the exception of a slight deposit of mold, easily removed, and a very small percentage of loose or broken specimens it is in excellent condition. While the bulk of the material is from the United States, and principally of the doctor's own collecting in the vicinity of his residence at Salem, Washington county, N. Y., there are also many species from all parts of the world received from exchanges with his correspondents, Drs. Sichel, Signoret, Fairmaire and Andrew Murray. The Coleoptera occupy eighteen boxes; the Orthoptera, seven; Neuroptera, six; Hymenoptera, eight; Lepidoptera, twenty-one, of which four only contain the diurnal species. Both divisions of the Hemiptera are nobly represented, the Heteropterous by fourteen boxes, and the Homopterous, to which as most naturalists are aware the doctor devoted especial attention, fill twelve boxes, and preserve as do the other orders apparently all the types of the descriptions published in the New York State Agricultural Reports, and other articles. Five boxes exhibit an excellent set of American Diptera with many exotic forms, and four are devoted to Myriapoda, Arachnida and Crustacea.

Some thousands of European and other exotic species received from Sichel, Signoret, A de la Cerda, and the late Rev. M. S. Culbertson, who collected at Hong Kong, appear never to have been incorporated with the main collection, but are generally in good condition, occupying twenty-five or more boxes of various sizes. Several hundred biological illustrations, principally "galls," &c., occupy three or four double boxes, and are now in good order, but very liable to be disarranged in the event of transportation.

Two cases exhibit a vast amount of patient labor on the Ceci-

domyia and allied genera, but have suffered seriously from the inroads of *Ptinus fur*, which we caught in the act of demolition.

An extensive collection of duplicates, including about one hundred thousand Coleoptera, and perhaps twenty-five thousand of all other orders, have been invaded by *Dermestes lardarius* and injured to an extent not exceeding twenty per cent. These are contained in two pine cases, each containing about thirty-six slides or rimless drawers, in which the pins are feebly secured by slits or incisions in the wood. There are no traces of *Anthrenus* or *Tinea*, and little if any of the more minute museum pests in any part of the collection.

One hundred and forty-eight small thick note-books contain in fine MSS., the locality, date of capture, &c., of nearly every specimen; their numbers reaching fifty-five thousand; the record commencing about the year 1833. Each species is accompanied by a brief diagnosis, followed on a subsequent page by a fuller description with notes and observations. The whole forming an almost exhaustive descriptive catalogue of the collection of inestimable value and which should of course never be separated therefrom. Several microscopes, among them a valuable upright Nachet with all accessories, made expressly for the doctor, only a few years ago, and a large and valuable library containing many rare and curious as well as unique works on entomological subjects are also stored in the small wooden building known as the "Office," a few rods in the rear of the hundred-year old homestead or dwelling-house.

An extensive collection of minerals, as well as a few specimens of local birds and mammals and a good alcoholic collection of the Washington county reptiles and fishes also attest the labors of the eminent naturalist.

— It is with sincere regret that we record the death, on January 23d, of Dr. Thomas M. Brewer, the distinguished ornithologist, whose geniality and courtesy won him friends all over the country, and whose labors as a naturalist entitled him to the warm regard of all lovers of nature. Dr. Brewer paid, as is well known, special attention to the study of the habits, nests and eggs of birds; publishing an elaborate and beautifully illustrated treatise on the eggs of birds; he supplied this part to Baird, Brewer and Ridgway's great book on the birds of the United States.

Dr. Brewer was born November 21, 1814, graduated at Harvard in 1835, and began the practice of medicine three years later. He was one of the oldest and most active of the working members of the Boston Society of Natural History; had just completed a catalogue of the large collection of humming birds of the Boston Society, in whose Proceedings most of his papers appeared, and had almost completed the collection of New England birds, which he had been at work upon f[illegible]

years. The society owes its large collection of bird's eggs, and many of its choicest native birds to his labors.

— Volume x of the new edition of the Encyclopædia Brittanica just issued from the press, contains a long and elaborate article by Prof. Archibald Geikie on Geology. It is nearly as comprehensive as the ordinary manuals on that subject, and will be still farther expanded into an advanced text book for schools and colleges, and published by Macmillan & Co. The article in the Encyclopœdia contains several sections, namely, the Cosmical Aspects of Geology, Geognosy, an inquiry into the materials of the Earth's substance, Dynamical Geology, Structural Geology, Palæontological Geology, Stratigraphical Geology and Physiographical Geology. Like all the former works of Prof. Geikie, this article exhibits marked originality and great literary merit. There are very few writers on scientific subjects on either side of the Atlantic who possess a more masterly use of the English language.

— We have received the first number of the *American Entomologist*, Vol. I, new series, edited by C. V. Riley and A. S. Fuller, and published by Max Jægerhuber, 323 Pearl street, New York. It worthily continues the first series of this journal which was suspended nine years since. The number is replete with entertaining and popular matter most useful to farmers and horticulturists, and deserving of the widest circulation. Articles on the hibernation of the cotton worm, by C. V. Riley, from advance sheets of Bulletin 3 of the U. S. Entomological Commission; on the food-habits of thrushes, by S. A. Forbes, and others of not less interest, with a number of shorter notes and paragraphs, render the contents varied and interesting.

— The grand Walker prize of the Boston Society of Natural History, founded by the late Dr. William J. Walker, and bestowed every ten years for excellence in original biological work, was, in January last, awarded to Professor Joseph Leidy, of Philadelphia. We need hardly say that the award will meet with the warm approval of every naturalist in the country, as Dr. Leidy, by his contributions to the comparative anatomy of both the Invertebrates and Vertebrates, to Vertebrate palæontology, his studies on the Protozoa, the intestinal worms, and the work he has done in other directions most justly entitle him to this prize, which is a substantial one, amounting to $1000.

— We have been delayed in noticing the second contribution from the E. M. Museum of Geology and Archæology of Princeton College, which embraces a topographic, hypsometric and meteorologic report by William Libby, Jr., and W. W. McDonald, of the Princeton Scientific Expedition to Colorado, Utah and Wyoming, undertaken in 1877. The report is of very considerable value and contains a number of excellent photographs of the mountain scenery.

— Theodore Fischer announces the publication of six of a series of Palæontological wall illustrations, which are one hundred ctm. broad, and one hundred and forty ctm. high, at the price of twelve marks a Lieferung, containing six plates, representing Protozoa, sponges, corals, Brachiopods and an ideal landscape of the coal formation. They are edited by Drs. Zittel and Haushofer. The whole collection will contain from forty-five to fifty diagrams, comprising seven landscapes, five or six plates of fossil plants, the remainder of fossil animals.

— The Boston Society of Natural History proposes, as a part of the celebration of its fiftieth anniversary, to publish a handsome quarto volume containing a series of illustrated articles in different branches of natural science, with a sketch of the society's history. The volume will contain several hundred pages and many plates. The price of the volume has been fixed at $10.

— Mr. Defrees, the public printer, will receive until June first, orders for the new edition of the Narrative of the *Polaris*, at two dollars per copy. The money must be sent him with the order. This is the splendid edition of which extra copies have been sold by authority of Congress at ten per cent. above the cost of press work and paper.

— Mr. P. N. Seminoff, of the Natural History Faculty of the University of St. Petersburg, desires North American Coleoptera in exchange for those of Russia. Any correspondence in regard to exchanges can be made through Hon. N. Shishkin, Washington, Russian Minister to the United States.

— Dr. A. E. Foote's *Leisure Hour* comes to us filled with useful information, especially on the subject of mineralogy. It also presents us with the fullest sale list of the publications of cotemporary American naturalists that exists, so far as we are aware.

— Mr. George A. Bates has established at Salem, Mass., a Naturalists' Bureau for the sale of works on natural history, authors' extras of their scientific papers, and specimens.

— Since the transfer of the NATURALIST to the hands of the present publishers, its subscription list has largely increased. We have increased the number of pages of the magazine with the present year, and have added to the number of illustrations. We hope our readers will bear these facts in mind and represent them to their friends. No popular scientific journal in the world possesses a corps of editors which includes so many names well known in American natural science. Our contributors are derived from the same class of workers, so that we do not exaggerate, we think, in asserting that the NATURALIST is indispensable to persons desiring to keep abreast of the times. We have also undertaken to publish an annual record of progress in science, which will be equally indispensable to the general reader.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Geographical Society, New York, January 13.—A paper was read by B. R. Curtis, Esq., entitled A voyage around the world.

February 10.—Prof. John B. McMaster read a paper entitled the Bad Lands, or Mauvaises Terres, of Wyoming.

New York Academy of Sciences, January 19.—Dr. H. A. Mott spoke on the diamond, its artificial production and uses.

January 26.—Prof. J. S. Newberry remarked on some peculiar silver deposits in Utah and Colorado, and Mr. S. W. Ford spoke on the recent discoveries of fossils in the limestone of the Wappinger valley, N. Y.

Boston Society of Natural History, January 21.—Mr. Diller replied to Mr. Crosby's remarks on the felsites north of Boston; Mr. Crosby made a communication on distorted pebbles in conglomerates.

February 4.—Dr. J. W. Fewkes described the pinnal sucker of certain Heteropods, and Mr. F. W. Putnam remarked on the former Indians of Southern California and their relation to the origin of the red man of North America. At the meeting of the Section of Microscopy, Mr. M. E. Wadsworth spoke concerning the cutting of rock sections.

Appalachian Mountain Club, January 14.—Prof. W. H. Niles delivered an address as the retiring president of the club.

February 11.—Prof. E. C. Pickering spoke on atmospheric refraction, and Mr. W. H. Pickering addressed the club in reference to future Arctic explorations.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

American Journal of Science and Arts.—February. Notice of recent additions to the marine fauna of the eastern coast of North America, by A. E. Verrill. The limbs of Sauranodon, by O. C. Marsh.

The Geological Magazine.—January. On some fossil bird remains from the Siwalik hills, India, by W. Davies.

Annales des Sciences Naturelles, 1879.—On the Plesiosaurians and Elasmosaurians of the Upper Jurassic, by M. Sauvage.

Quarterly Journal of Microscopical Science.—January. On the development of the Spermatozoa. Part I. Lumbricus, by J. E. Bloomfield. On the spinal nerves of Amphioxus, by F. M. Balfour.

Canadian Entomologist.—January. Description of the preparatory stages of *Grapta progne*, by W. H. Edwards.

Canadian Naturalist.—December 29, 1879. Preglacial formation of the beds of the Great American lakes, by E. W. Claypole. Note on recent controversies respecting *Eozoön canadense*, by J. W. Dawson.

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PROTOPLASMIC DYNAMICS.

BY PROF. W. S. BARNARD, PH.D.

THE present general tendency of natural science is towards unification. Formerly it was truly " natural history," analytically descriptive and distinctive, while morphological classifications were formed on external resemblances known as analogies, or on internal structural analogies entitled homologies. But this stage of culture has passed its maturity, while the investigation of processes has introduced the natural, synthetic, explanatory stage, with its abundant results now appearing.

The derivation of the physical forces from each other by transmutation, and from chemical and mechanical actions, which they are capable of originating again, the development of organisms from protoplasm, a substance, which, with its functions, all have in common, and the doctrine of the evolution of species, present only some of the most important advances made toward a unitarian system combining all objects and operations together as they are derived from each other. While some chemists expect that organic chemical combinations may yet be obtained by uniting inorganic molecules in the laboratory as in the bodies of plants, and there are those who think with Haeckel that the very lowest living forms may arise by spontaneous generation from the higher carbon compounds, the physiologists have decided that there are chemical changes and physical forces associated with, and seeming to have a causal connection with, the production of organic powers and functions. But there can be no positive certainty of this transition unless we can show *how* and *why* it necessarily results. To effect this and to attempt to trace out the systematic

combination of some of the fundamental operations, whether physiological, mechanical, physical or chemical, as they exist in one continuous process pertaining to protoplasmic things, is my present undertaking.

I.—Protoplasm masses and molecules, or their parts, may be set in motion by the impact or attraction of active masses or molecules or atoms, without or within.

The agitations thus imparting themselves are various and, because communicative, may be regarded as excitants or incitive actions, already called stimuli or irritants. These include *mass-motions*, such as pressure, blows and friction; *molecular motions*, chiefly vibratory or oscillatory, as sound, electricity, light and heat; also *atomic motions;* and with these are the *attractions* belonging to these divisions of matter respectively, as gravitation (weight), cohesion and adhesion (osmotic, diffusive, capillary, &c.), and finally chemism. Important sources of some of these are the chemical reactions of oxygen, water, and the ingested nutriment, constituents with each other and with the protoplasm elements; others proceed from contact with the active materials of the environment; while the sun also continually contributes.

II.—All the above disturbing forces tend to cause the displacement, mutilation, fission or decomposition of molecules or their parts, which is especially easily accomplishable against weak combinations of ponderous, complex molecules, such as distinguish organic bodies.

III.—When molecules or their parts are thus separated, their combining powers are set free, and this liberation of attractional forces will be sustained by the continued operation of the original displacement forces, or may become, to some extent, self-propagated after their cessation by the disturbance (heat, &c.) resulting from recombination; for the impact of every union manifests itself in new disturbing force, which, in turn, may disband other attractions, from which further combinations follow.

An illustration of this self-sustained process is common in every form of combustion. The little heat-agitation applied to a very small part of the mass to be consumed, frees attractions there, which satisfy themselves by uniting with the ever-present oxygen, thereby generating more heat, sufficient to renew itself by inducing further chemical reaction so long as fed with the material for consumption.

IV.—These free combining powers, acting together, constitute plasma attraction or affinity, and are the force and source of organic power. Their mode of utilization we shall see further on.

Though strange indeed that attraction as the great fountain of power in organisms has been overlooked, it has probably remained so from lack of seeing the application of this most abundant of all forces to the driving of the vital machine, even as we were late in learning the use of the expanding power of steam. Without looking among the attractions for the propelling power, the impression has prevailed that if anything is necessary, more than the assumption of an independent vital force, it must be looked for in forces like heat and electricity, which are freed by chemical combination, and evidently are of great importance, especially in the higher organisms as communicative and excitive of agitations inducing the liberation of attractions which collectively constitute the immediate organizing and working power. Concerning this matter Herbert Spencer (Princ. Biol., Vol. I, pp. 55) says, "*We have as yet no clue to the mode in which molecular movement is transformed into the movement of masses.*"

Also in this connection three papers may be cited as fairly showing the chief facts and theories bearing on this question and respectively pertaining to the three kinds of active tissues of the higher organisms:

1. Engelmann. Die Flimmerbewegung. Jenaische Zeitschrift, Vol. IV, 1868.
2. Charles. The mode of Propagation of Nervous Impulses. Journal of Anatomy for October, 1879.
3. Armsby. The source of Muscular Power. Popular Science Monthly for October, 1879.

The first of these is an exceedingly important volume of investigations, showing the effects of chemical re-agents, and the physical and mechanical forces in accelerating or retarding, introducing or stopping the action of dead and living cilia, also affirming the constancy and fundamental importance of the *imbibitional swelling*, and the conclusions of others, that *like reactions are obtained from all the contractile tissues.*

The second defines the two propagation-processes attributed to nerve impulses; the *vibratory* hypothesis and the *chemical* hypothesis, giving the facts on which the latter is founded, with the conclusion that it necessarily partly includes the former.

The final decision will probably be that both these processes exist throughout the gray protoplasm of the nervous system, but that the chemical predominates in the ganglial cells, the vibratory in the axial plasma.

The third is a presentation of the chief facts and conclusions pertaining to its subject, and with such decided bearings on the topic before us that we must notice it more particularly. By way of introduction the following statements represent a doctrine which is now largely taught and accepted.

"The question of the source of muscular power is essentially a question concerning *transformation of energy.* The most characteristic distinction between plants and animals is, that the former *appropriate force from outside themselves, from sunlight, and store it up as potential energy in the various complex compounds which they form in;* while animals draw their supplies of force entirely from those compounds in which it has been stored up by plants, and from which it is set free again when they are decomposed in the organism."

"In a word, the plant converts the actual energy of the sunlight into the potential energy of organic compounds, the animal converts the potential energy of the organic compounds into actual energy, which manifests itself as heat, motion, electricity, etc.; in the plant the spring is coiled up, in the animal it uncoils, exerting an amount of energy equivalent to that which coiled it. One of the forms which this energy takes on is that of *muscular motion*, which we thus trace back to the *potential energy of food*, and through this to that great source of all energy to our earth, *the sun.*"

"We are not, however, satisfied with knowing in this general way that it is *the food* we eat which *serves as a vehicle to convey to us our needful supply of sun-force.*"

We agree that there is "energy of food," that "plants store up * * * * energy in the various complex compounds which they form in," but when it is called "sun-force" appropriated "from sun-light" and stored up, we dissent, for it is attractional force inherent in terrestrial matter independent of the sun, and from which probably none has been received since our globe was a part of her fiery mass. Similarly Professor Carpenter (Correlation and Conservation of Forces, pp. 404–5) speaks, "Thus in either case we come, directly or indirectly, to solar radiation as the main spring of our mechanical power; the *vis viva* of our whole microcosm." And thus too much power is now-a-days often attributed to the present influence of the sun and the undulatory

forces, and too little to the attractional forces of matter. The author speaks of the force several times as "potential" and "latent" energy, but these words in such connection are worth no more than blanks. This valuable conclusion agrees with that of Professor Flint (and others),—"All the facts seem to indicate that muscular force originates in *a splitting up of some substance in the muscle accompanied by the liberation of force*" (p. 822). The next conclusion should be that *combining power* is the only *immediate* force that can be freed by fission among muscle molecules. This will appear if we thoroughly understand the nature and relations of the powers in question, for it is necessary to distinguish all forces sharply into two groups: 1, the *attractional* (gravity, adhesion, cohesion, chemism), and 2, the *impactive* or momentum forces of masses, molecules and atoms (in mass-motions, sound, electricity, heat and light). Those of one group are *not convertible* into, but *oppose* those of the other, and while the latter set may, by opposition, often disengage the former, the latter are but the *recoil* (which may propagate itself) from the actions produced by the former group.

V. The plasma-affinity, which is the joint action of its freed attractions, is its imbibing force, exerting a hydraulic suction power, manifested in a circulation into the part affected and the resultant swelling of the same, from which all the mass motions of organisms proceed.

The initial movement is the circulation among the attracting molecules with its general direction toward the point where the greatest amount of chemismic power is being freed, and such as necessarily precedes chemical unions of dilute fluid constituents with those of fixed, elastic, porous bodies; for the matter imbibed consists of the water solution of oxygen, nutriment and disengaged plasma-molecules. Most common examples of expansive and circulatory movements resulting from combining power are not in their details parallel with those of the protoplasmic substance. The activities from heat and from affinities freed by heat in ordinary combustion, which naturally come to mind first, present an altogether different case. If the combining element, oxygen, was only in a solution permeating everywhere to act throughout the entire mass, the resultant activity would be, instead of a swelling of heated surrounding air, an expansion of the solid mass. And we must also remember

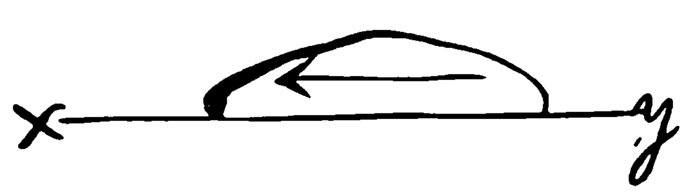
that the protoplasm contains, besides oxygen, many other reagents as its stored food-constituents; that there are also more of the volatile elements in its composition, which is more complex while its consistency is that of elastic viscosity. Further, the oxidation in organic fluids cannot be so intense and generates but a comparatively small amount of heat, so little that it is eliminated by conduction without appearing in such vast quantities as to induce a boiling or convectional circulation, while the chemical reactions of the organized plasma-components are exceedingly slow and weak, yielding but little heat.

The intersusception and interpolation of new matter into the plasma is by *imbibition*, which also is the method of ingestion of nutriment by the plasma of cells and the lowest organisms. This imbibition process is a well-established concomitant to all plasma-action, but while its value as a nutritive power determining the peculiarities of nutrition and growth has been esteemed, its great importance in the production of *mass-motions* has not become understood.

VI.—*Imbibitional swelling*, in some respects, simulates that resulting from inorganic absorption and diffusion, but is markedly different, especially since the engaged combining powers act stronger than those freed, so that it does not result in a dissolution or solution of the imbibing substance, while the increase of distension intensifies its tension and elasticity. To understand the possibility of this swelling without rupture of the chemismic bonds in organic bodies, we may have to regard their constituents as grouped into filamentous branches or a spongy mesh, in symmetrical order, and remember that they are certainly very complex, for, according to recent chemical theories, some of the albumenoid molecules may contain a thousand atoms.

Let us now classify the principal *kinds of plasma-motion* while trying to explain how each is attained.

1. *Axial Procession.*—Let x—y represent a surface on which a

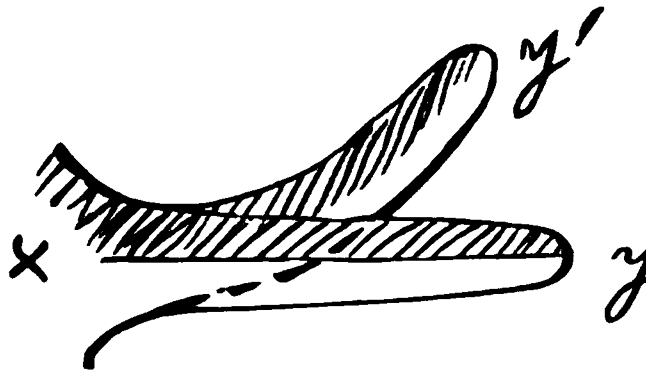


a lump of plasma is shown in section, the heavy portion of its outline indicating that part of its surface which is acted on by light or some other decomposing force. Imbibition from within to this tract is induced and it swells thereby advancing slightly toward the light, while gravity pulls it down so that an advancing descending movement of the front margin

results while the upper and inner adjacent plasma supplies its place to swell and follow, and so on, the mass advances. This kind of motion is very common in some Amœbas.

2. *Axial Exsertion.*—The imbibitional swelling may be still more local from either external or internal excitation and thereby produce pseudopodal protuberation, and in Amœbas we often observe the transition from the pseudopodal to the total procession. In both cases these animals show a marked circulation towards the swelling point in the protruding part.

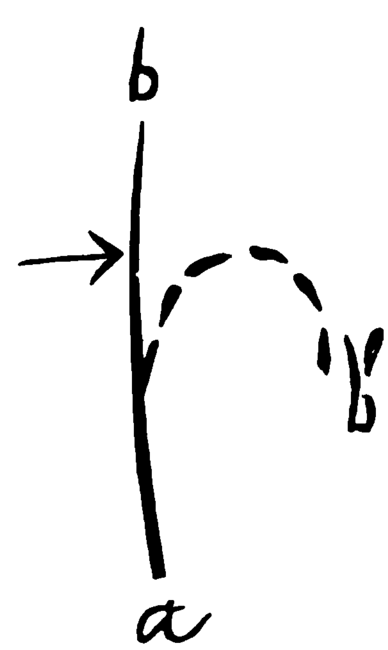
3. *Lateral Deflection* may be produced in any elongated mass by lateral superficial imbibitional swelling, as in the light area of the pseudopod *x—y* causing its deflection to *x—y'*. By this method alternating from side to side, the vibrations of the pseudopods of free-swimming, rotating rhizopods and the flagellate and ciliate action of infusorians, rotifers



and other organisms are effected, probably under control of electro-chemical impulses in their own substance. The sort illustrated above may be called the monomeric while the polymeric or undulatory form also appears as shown in the figure, the white swollen regions being several and alternately dis-

posed. Again, should the imbibition follow a spiral line, spiral contortions and cycloidal figures result.

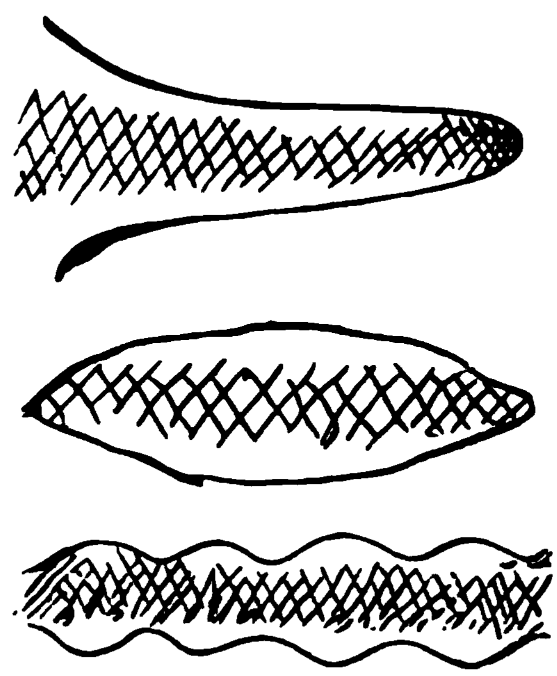
A good method of showing imbibitional deflection is to use a very thin strip of gelatin, such as is employed by lithographers for tracings. Let *a–b* represent the sheet as seen edgewise and standing erect, held at *a*. Now if it be breathed on gently at the point indicated by the arrow, it will quickly bend over to *b'*. This is by imbibition of the moisture of the breath on one side causing it to swell. The thinner the sheet is the quicker will the flexure appear, and by comparison we may judge that with filaments as fine as cilia it should result with the same rapidity that characterizes cilia motion. The thin mass erects itself as promptly



of its own accord, but still more sudden if moisture be breathed

on the opposite side. And thus by breathing on one side and then on the other the vibration back and forth may be produced several times. Of course, in actual cilia the conditions are very different, for the material to be imbibed is ever present, while the imbibitional attraction is alternately freed first on one side and then on the other apparently by a chemico-electric, electro-motor process. And those who think it necessary to suppose a vital force here must be reminded that, according to Engelmann (op. cit. pp. 463–4), weeks after death, on stinking, decaying membranes, the cilia can be set in action by adding their normal conditions of oxygen, water and temperature.

4. *Zonate expansion with axial contraction*, in a monomeric form pertains especially to such retractile parts as pseudopods, some cilia, and unstriated muscle cells, from imbibition in a zone of the conical or cylindriform part. The engorgement of this zone causes an influx into it shortening the long axis and tending to yield a spheroid form. In this way muscle cells and pseudopods broaden and shorten themselves, the latter sometimes to such an extent as to attain the diameter of the main mass, into which they thus merge. In the diagrams the light parts represent the expanding zones. With the polymeric form of the striated muscle cells, undulatory outlines result from the swelling of many successive zones giving greater and quicker contraction than in the smooth spindle cells. In this connection it must be borne in mind that a muscle's action is only a resultant of the joint action of all its cells and that attraction is the *vis a tergo* of organic expansion and contraction.



5. *Contra-actional retraction* we can presume as the reverse of the exsertive, its center of imbibition being at the base of the pseudopod which becomes drawn to it.

6. *Sphærogenic ballancement* would occur from equal expansion in all directions and cause the mass to assume a spherical form.

VII.—The processes described above produce all the *mass-motions* of organisms, which are of many kinds and may be chiefly grouped as:

1. *Locomotive*, for transporting individuals from place to place.

2. *Supportive*, for maintaining the normal relative position of parts and opposing gravity.

3. *Prehensional*, including all kinds of manipulatory actions.

4. *Peristaltive*, the motor actions of hollow organs on their contents, embracing swallowing, gastrition, peristaltition, the contractions of sphincters, the heart, blood-vessels (circulative), &c.

VIII.—The molar and mass-impact and frictional wear and tear from the above operations yield mechanical heat and electricity with structural degeneration.

IX.—To maintain the conditions of all these activities the combining process must go on intermittingly or constantly. The fractional molecules must unite with each other, with imbibed food-constituents (nutritive assimilation) or with oxygen.

X.—From this we have chemical heat and electricity with the processes of protoplasmic extraction, secretion and excretion of fluids. Though heat and electricity must naturally appear more or less from all the chemical unions in plasma of whatever tissues, we may look upon the oxidizing process as the greatest source of chemical heat, while the ganglial and muscle cells are to be looked upon as the batteries in which chemical combination generates most of the neural electricity. To illustrate the relations existing here, we may suppose the light to cause molecular agitation in the retinal nerve-ending and to propagate itself inward. Entering the ganglial plasma, it frees attractions, whence recombination results, generating nerve electricity discharged along the motor nerve and naturally causing some chemical reaction in it, but producing its greatest effect in the terminal muscle cell, which is charged as a receiver, the continued agitation keeping its attractions freed, sustaining imbibitional zonate expansion with axial contraction, from which mass-motion results. In the so-called voluntary motion it would seem as though the ganglial agitation was excited from within and the same consequences follow. The recombination occurring in the muscle substance probably also generates recurrent electricity, which reacts upon the nerve centers.

Finally, organic combining power is not only motor power, but also "growth-force," the *vis a tergo* of plasma-nutrition, growth and development, producing (by coöperation with conditioning forces) all the diverse and wonderful form-phenomena,

the kinds of which, like the varieties of mass-motion, are determined through localized imbibition. On this account, and because the motor acts have laid out the paths of growth, the parallelism between the series of morphological processes and of the motor processes is strikingly complete; but a presentation of these details, in the same order, must remain for the future.

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A SKETCH OF COMPARATIVE EMBRYOLOGY.

BY CHARLES SEDGWICK MINOT.

II.—THE FERTILIZATION OF THE OVUM.

IN the previous article we traced the relation of the genoblasts, or sexual products, to the cells from which they arise. We have now to consider the manner in which these products effect the creation of a new and complete animal. Now, the bodies of all animals are composed of cells and the productions of cells, hence to make an animal the first thing is to furnish cells. According to the theory propounded in the last article, an egg represents one part, a spermatozoōn another part of a cell, hence a fusion of the two would again make a single perfect cell. This fusion actually occurs, and is called the impregnation or fertilization of the ovum.

Our knowledge of this phenomenon is extremely imperfect. It has, however, been the object of several important researches during the last few years, but we must wait for much more extended investigations before we can make any satisfactory generalizations. The following order of events is that which our present knowledge renders most probable—it must be remembered that we are dealing only with a probability. A *single* spermatozoōn enters the egg and fuses with it. After the ejection of the polar globules, the nucleus of the egg is a small body which lies near the periphery, immediately underneath the globules. It then is called the *female pronucleus*, and travels—why or how is not known—towards the center of the egg, where it finally remains. A system of radiating lines runs out from it into the yolk, making, together with the pronucleus, the so-called female *aster*.

At some time during these changes, whether sooner or later perhaps does not matter, a single spermatozoön enters the egg. As the egg or yolk is surrounded by envelops, it is evident that either the spermatozoa must enter before the coverings are formed, or that it must have some way of passing them. For instance, in the hen the spermatozoa attain the yolk before the hard shell is formed in the oviduct. In other instances there is a special opening, often having a peculiar structure, which admits the passage of the spermatozoa, and is called the micropyle, Fig. 10. This opening is of course not an essential part of an egg, and merely permits the egg to be protected by an impermeable shell without excluding the spermatozoön. It is asserted that in some cases the micropyle is not a real opening, but only a permeable spot through which the spermotozoön can work its way (Kupffer).

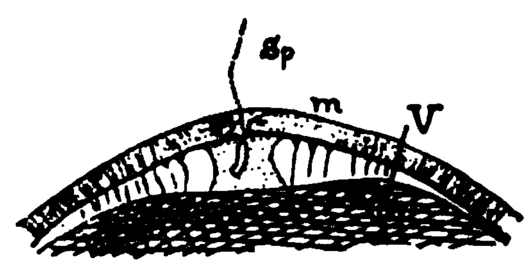

FIG. 10.—Spermatozoön entering the yolk of Petromyzon, the head having already traversed the micropyle; after Calberla.

It was stated above that only a single spermatozoön enters the yolk. The way in which the entrance of a second one is prevented is not definitely determined yet. It has, however, been stated by Fol and by Kupffer and Benecke that in the eggs observed by them (star-fish and lamprey) there is no vitelline membrane around the egg until after impregnation, when a complete envelop is rapidly formed by the yolk, effectually excluding all other spermatozoa. If this view is correct, then the egg has no proper cell membrane until after its fertilization; and all the coverings it has before that event, are only secreted around it by other cells, and not by itself.

When a spermatozoön penetrates into an egg, the head goes in first; after which the nucleus it contains loses its peculiar shape, transforming itself within the yolk into a small spherical or irregularly-shaped *male pronucleus*. The tail disappears—how is not known. This pronucleus, like the female, is surrounded by radiating lines, so that there is also a male *aster*. At this time the egg, as shown in Fig. 11, contains two pronuclei, and is still connected with the polar globules. The second pronucleus also travels towards the center of the egg, where the two pronuclei meet, both having meanwhile enlarged considerably. After coming in contact the two pronuclei fuse completely, making a

single body, to which the very appropriate name of segmentation nucleus has been given. Possibly a contraction of the impregnated egg always occurs, either during or immediately after the entrance of the spermatozoōn, so that a space intervenes between the yolk and the envelops of the egg. As little heed has been paid to this point, we are uncertain about it.

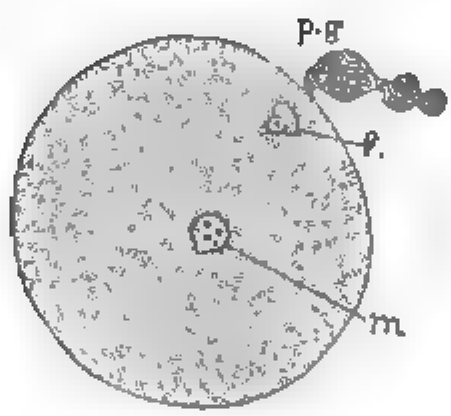

FIG. 11.—Egg of Nephelis three hours after laying. *m*, male,—*f*, female pronucleus; *p.g.*, polar globules; after Hertwig.

We thus have seen that a male and female element unite and make a single perfect cell. This fact offers a very strong support to the theory that cells contain two sexual constituents in a latent condition, and are therefore to be considered either hermaphroditic or sexless.

It has long been known that the egg of every animal must be impregnated by the spermatozoa of its own species, while on the other hand reproduction is dependent upon a certain dissimilarity, the existence of which is well established, although its nature cannot be even hypothetically explained. When the parents have been closely related for several generations, the sexual products alter in such a way that they cannot produce a complete animal by their fusion, although fusion with an element from another less closely related individual is still effectual. From these circumstances arises the necessity of cross breeding, a fact which has been so much discussed in public that I need not occupy further space to describe it. In a very few cases the genoblasts of nearly related species may unite efficiently, producing an animal partaking of the character of both parents—in short, a hybrid. Such exceptions are, however, extremely rare.

Since the offspring inherit the peculiarities of the parents, it is evident that the transmission must take place through the genoblasts, and various theories have been propounded to account for it, but no view has yet been brought forward which can justly be termed satisfactory, not even excepting the theory of pangenesis.

The formation of the impregnated egg, with its segmentation nucleus, marks the beginning of new cycle of life, for the cell so formed is endowed with a mysterious and remarkable power, which entirely distinguishes it from almost every other kind of cell known at present. The fertilized ovum is charged with forces

which cause it to divide into numerous cells, and cause these cells to arrange themselves upon the model of the parents which formed the egg and spermatozoa, and to imitate the peculiarities of the cells in each locality, making an eye where the parent had an eye, a gland where the parent had a gland—only the imitation is imperfect, the offspring is not absolutely the same as the parent. Evidently the fusion of the genoblast is the source of an increased vitality and of a formative power which is specific in each case, *i. e.*, the action and result of which is predetermined.

This marvelous formative power has always excited the interest and astonishment of naturalists. It is one of the fundamental distinctions of life, since no similar power occurs in inorganic nature. It is important to note, therefore, that it must enter into all cells, otherwise some of them would not form in the right place and manner. That other cells than the fertilized ovum contain such a power is shown by the formation of buds and strobila, and more strikingly by the development of *pseudova.* In the latter instance, the development begins with a cell arising in the ovary, and which resembles an ordinary egg very closely. Such cells are formed in various animals, notably in the plant lice, but, although they are so like eggs, the pseudova differ by being capable of developing into a complete animal without impregnation.

For want of space, it is impossible to describe the formation of buds and strobila, let it therefore suffice to say, that the reproduction depends in both cases upon the separation of a *cluster* of cells (instead of a single cell or pseudovum) from the body of the parent. This cluster grows up into a complete animal, in which the structure of the parent, or sometimes of the grandparent, is imitated by the action of the formative force of the cluster of cells. Hence it is evident that a similar power is bestowed upon several cells, which is the thesis we started to prove.

III.—SEGMENTATION AND THE FORMATION OF THE GASTRULA.

After the impregnation has been completed, and the two pronuclei have fused, to form the segmentation-nucleus, there usually follows a period of quiescence, during which no visible changes occur. It is not known whether such a period is always intercalated in the course of development; but it has been observed frequently. After this pause the process of segmentation begins, which has for

its essential purpose the multiplication of cells; the further history of the egg is a description of the way in which the cells, constantly on the increase, arrange themselves in definite order, until they have gradually created, or, more truly, become, the adult animal. The object of embryology is to discover the laws according to which this arrangement is developed.

We, of necessity, begin with a study of the process of segmentation; but the details are so numerous that we can indicate only a few of them. The first result is the formation of two sets of cells. In one set the cells are small; in the other set they are large. Except in the sponges, the small cells form the outside covering of the body, appearing as a sac, or vesicle. The large cells form the lining of the digestive canal, or primitive stomach, and are, therefore, enclosed in the outer vesicle made by the small cells. It appears that this disposition arises in two entirely distinct ways. First, the cells formed by segmentation arrange themselves in the shape of a sphere, hollow inside, and its walls consisting of a continuous layer of cells. One half is composed of small cells; the other half of large cells. Second, the result of segmentation is likewise a hollow sphere, but with double walls; the outer wall of small cells, the inner wall of large cells. In both cases the sphere transforms itself into a so-called *gastrula*. In the first instance, the large cells become inverted inwards, or, in technical language, invaginated; while the small cells grow down and around the others, until they encase them, leaving only a small opening, the primitive mouth. In the second instance, an opening breaks through both walls, thus making a mouth. This method of development is much rarer than the other, and unfortunately has never been studied in a thoroughly satisfactory manner.

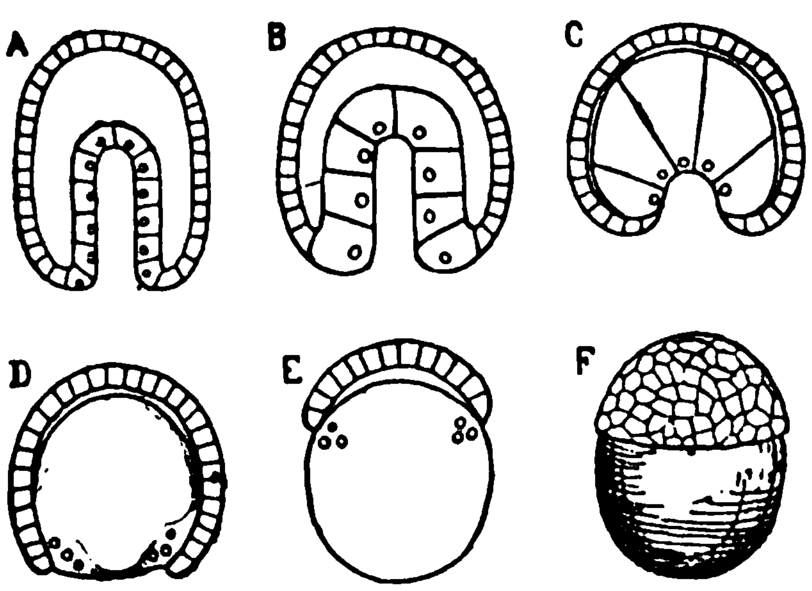

FIG. 12.—Diagrams of the principal modifications of the Gastrula. *cf.* Text. *A–E* represent sections.

The accompanying figure displays diagrammatically the principal forms of gastrulæ. *A* is a very simple form, such as occurs among Echinoderms. The difference in size between the two sets of cells is slight, but evident. In *B*, the difference is more marked,

and fairly represents a gastrula of *Amphioxus*. In *C*, the difference is very great, and corresponds to a form observed in certain Gasteropods. In *D*, the inner set is no longer separated into distinct cells, although there are a number of nuclei, each of which marks the center of a future cell. In such an instance we should regard the whole inner set as a nutritive yolk, not yet transformed into a definite cell-layer. This figure is particularly instructive, because it shows that what we call the yolk is not something distinct from the germ, but really belongs to the inner layer of the embryo. *E* shows a similar egg, in which the outer set of cells has not yet grown around the yolk. This outer layer was called by the earlier embryologists the blastoderm, in all those eggs with a great deal of yolk. *F* shows the same egg not in section, but seen from the outer surface, to exhibit the cap of small cells, or the blastoderm, resting upon the large yolk. Those eggs in which the difference in size between the two sets of cells is not excessive (A–C) are called *holoblastic*, while those in which the yolk remains more or less intact for a considerable time (D–F) are termed *meroblastic*.

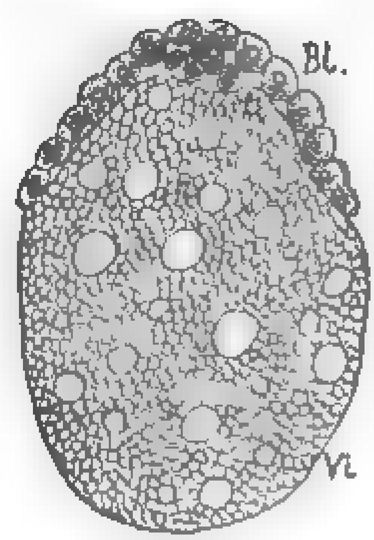

FIG. 13.—Formation of the blastoderm in *Oniscus murarius*, after Bobretzky.

In order more fully to illustrate the peculiarities of the process of segmentation, it is necessary to consider the holoblastic eggs further. Fig. 13 represents an actual section of an egg of the sow-bug, *Oniscus*, after Bobretzky, corresponding very nearly to the diagram *E*, of Fig. 12. Fig. 14 is a similar section through the egg of a moth (*Pieris crataegi*), and shows a number of nuclei, each surrounded by a little mass of protoplasm, and scattered irregularly through the yolk. Their number gradually increases, and each one becomes the center of a distinct cell. This is merely a peculiar modification of the ordinary method of cell division into two equal parts, for in the moths and butterflies and some other animals the large yolk divides gradually, by forming several nuclei, and so breaking up into a considerable number of cells piled up one over the other. We shall have oc-

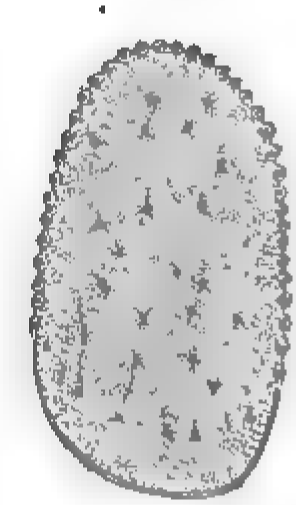

FIG. 14. — Section of a segmenting egg of a moth; after Bobretzky.

casion to recur to this matter in speaking of the development of vertebrates.

The embryology of sponges is important because they do not have any gastrula. It will be described in our next article. Except in the sponges, the small cells form the outside layer and are called the *ectoderm*, while the large cells form the inside layer, or *entoderm*. In England the attempt has been made to substitute epiblast for ectoderm, and hypoblast for entoderm, but the change seems to me useless and confusing. In face of the present tendency to substitute new and difficult for old and simple names every protest is desirable. Compounding English polysyllables from Latin and Greek confers, in most cases, no benefit to science. The coining of such terms ought to be restricted in its application to things which have no accepted name and for which no straightforward English term can be found.

The next progress after the formation of the ectoderm and entoderm does not occur among all animals, but only in those above the Cœlenterates. I refer to the development of a distinct middle layer of cells, the *mesoderm*, situated as shown in Fig. 15, between the two primitive layers. Of the origin and characteristics of the mesoderm I shall treat in the next article.

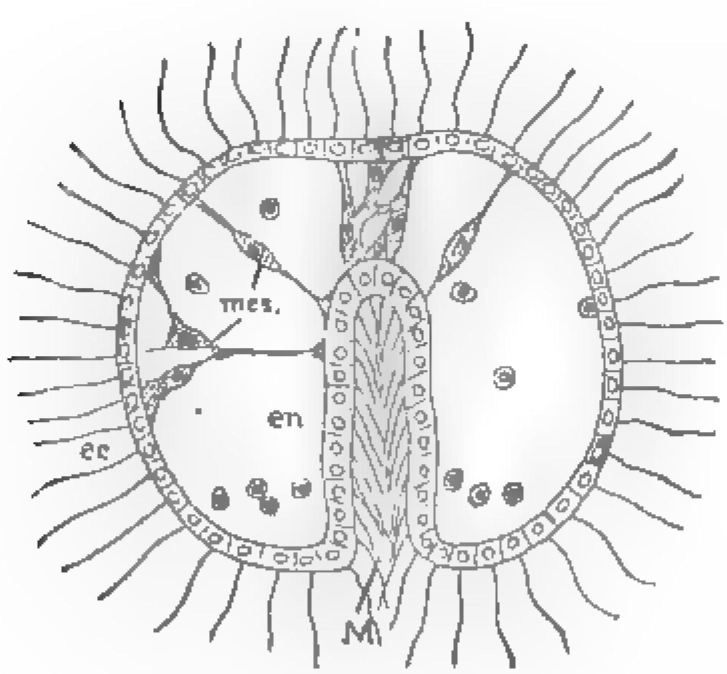

Fig. 15.—Section of a gastrula of *Toxopneustes lividus*, after Selenka; *mes.* mesoderm.

A great many embryos live in the water, and have the power of locomotion long before they have any muscles. For this purpose the ectoderm in these forms is provided with cilia or vibratile hairs, which may be longer (Fig. 15) or shorter. In most free embryos, moving by cilia, we find distinct bands, along which the cilia are more developed and powerful; as the ciliated bands are often pigmented, while the rest of the embryo is transparent or light-colored, they are very conspicuous. We shall have to recur to them.

The authorities for the general views advanced above are the

discussions in a long series of special papers. Prof. Haeckel[1] has written a great deal upon the gastrula and its significance, and has published several popular works on embryology. Unfortunately, he is inaccurate and untrustworthy to a degree surpassing any other scientific writer I can recall, for on almost every page are mistakes it requires little knowledge to detect. He is, therefore, utterly useless to the beginner. I mention this, not alone as my personal conviction, but also as the judgment of competent and distinguished critics, some of whom are even more severe in their condemnation. For these considerations I shall not quote Haeckel as an authority. The references to some of the special papers I have consulted will be given hereafter.

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[1] "Professor Haeckel's principal articles on the Gastrula are to be found in the *Jena Zeitschrift für Naturwissenschaften*, Band. VIII, p. 1, and *Biologische Studien*, 2tes Heft. 1877. Haeckel introduced the term *Gastrula*, and his writings and speculations have afforded a powerful stimulus to embryological research."

PROGRESS OF INVERTEBRATE PALÆONTOLOGY IN THE UNITED STATES FOR THE YEAR 1879.

BY DR. C. A. WHITE.

AS the operations of men's minds are not subject to the calendar, it is difficult to select any specified period of time and say just what progress in any one branch of investigation has been made within it. Therefore, in this popular review of American palæontological labors for 1879, both the distal and proximal boundaries of the year will be held somewhat loosely. That is, in giving a summary of the work done, all writings will be mentioned which have been published either originally or in their latest form, even such as appeared in the earliest days of the year; and mention will be made, not only of such works as are known to be in press at the close of the year, but also of such as are known to be in course of preparation then. These anticipatory notices have been made from information kindly communicated by the various authors who are referred to. No work, however inconspicuous, has been intentionally omitted from bibliographical notice, but even the most obscure are mentioned, leaving the question of sufficiency or insufficiency of publication to be decided by the custom of naturalists. The writer, in connection with Prof. H. Alleyne Nicholson, having published a Bibliography of North American Invertebrate Palæontology, which, with a supplement, extended to the close of the year 1878, the following account of the publications for 1879 may be made, to serve rudely as a continuation of the portion of that bibliography which relates to the United States. The reader may readily separate this bibliographical matter from the personal gossip, of which the article is largely composed.

The list of Americans now living who have at some time or other, and to a greater or less extent, contributed to the literature of invertebrate palæontology, is a rather long one, and yet the names of a large majority of them do not appear in connection with any publication of the past year. Among the active workers in this field is first to be mentioned the veteran palæontologist, Prof. James Hall, who is still engaged with his great series of works for the State of New York, upon which he has bestowed the unremitting labor of almost forty years, no one of which has been more fruitful of important results than the one just passed.

Volume v of his great series is just completed, and will, doubtless, be in the hands of scientific workers within a few weeks. It is in two parts—really two volumes—part I containing the text, and part II the plates. I regret that it has not been practicable to obtain a résumé of the contents of this volume, but it is safe to say that it is a worthy companion of any one of the series which has preceded it, the appearance of each one of which has marked an epoch in the literature of American palæontology. In 1862 Prof. Hall published in the Transactions of the Albany Institute, descriptions of a large and remarkable collection of Niagara fossils at the then newly-discovered locality near Waldron, Indiana. In 1876 he published in the documentary edition of the Twenty-eighth Report of the Regents of the University of New York, full illustrations of these fossils, but without any accompanying text. In the museum edition of the Twenty-eighth Report, just printed, Prof. Hall publishes full descriptions of all those fossils, together with the republished illustrations, embracing more than one hundred pages of text. In March of 1879, he also read before the Albany Institute, "Descriptions of New Species of Fossils from the Niagara Formation at Waldron, Indiana." This work is now published in the form of a twenty-page pamphlet, and contains descriptions of upward of forty new species and one new genus. *Ampheristocrinus.* Palæontologists will rejoice that this remarkable fauna of the Niagara period is at last fully before them. In addition to the descriptions and illustrations of the Niagara fossils, Prof. Hall also publishes in the Twenty-eighth Report just mentioned, a paper, illustrated by three large plates, entitled "Notice of some remarkable crinoidal forms from the Lower Helderberg Group." He here establishes the new genus *Camarocrinus*, of which he describes three species. A part of the remarkable fossils upon which this paper is based have been in the hands of Prof. Hall for many years; and a part of them were lately collected in Tennessee by Prof. J. M. Safford, who read a paper on them last summer at the Saratoga meeting of the American Association for the Advancement of Science. Besides these important works, Prof. Hall has a brief illustrated article on the genus *Plumulina* in the Thirtieth Report of the New York State Museum, just published, and he also read a palæontological paper at the Saratoga meeting of the American Association for the Advancement of Science. The Thirty-second

Report of the New York State Museum is in press; it contains descriptions of the Bryozoa of the Lower Helderberg group, adding fifty or sixty species to the list of those published in a former report; all being the work of Prof. Hall.

The time of Prof. R. P. Whitfield, for the past year, has been largely employed in his duties at the American Museum of Natural History at New York, and at the Troy Polytechnic Institute, but he has, meantime, continued his work upon the Palæontology of the States of Ohio and Wisconsin, the results of which are to appear in Vol. III of the former and Vol. I of the latter, respectively, both of which volumes are well advanced toward completion. At the Saratoga meeting of the American Association for the Advancement of Science, he read a paper on the Occurrence of rocks representing the Marcellus shale of New York, in Central Ohio; and published in the September number of the *American Journal of Science and Arts*, p. 22, a notė on the Occurrence of *Maclurea magna* in the Barnegat (Chazy) limestone near Newburg, N. Y. These are brief papers, but they are important applications of palæontological identification of fossil forms to the elucidation of geological problems.

Besides these, he has published in the same journal for January, 1880, pages 33-42, an article on "New Forms of Fossil Crustaceans from the Upper Devonian of Ohio," in which he proposes the genera *Echinocaris* and *Palæopalæmon*, describing three new species under the former, and one under the latter genus. He has also prepared a description and figures of a large and interesting Cretaceous brachyuran crustacean, *Paramithrax* (?) *walkeri*, which will appear in connection with the palæontological work of the writer of this article, in the Annual Report for 1878 of the U. S. Geological Survey, lately in charge of Dr. Hayden. His work for the Palæontology of Ohio will be illustrated by from fourteen to eighteen plates of figures. One of these plates will be devoted to the illustration of his new forms of Devonian Crustaceans already mentioned, and one of them, in part, to the illustration of those forms upon which he bases his conclusions of the occurrence of Marcellus shale in Ohio, also before mentioned. The report will contain descriptions of new and known forms from the Lower Helderberg, Upper Helderberg and Upper Devonian; also the entire known fauna of the Maxwell limestone (=Chester and St. Louis series) and some other upper and lower

Carboniferous forms, some of which are referred to the horizon of the Burlington limestone.

His work on the Palæontology of Wisconsin is now ready for the printer and engraver, and will be issued some time during the year 1880. A total of one hundred and eighty-nine species are illustrated by twenty-six plates of figures, which fossils are referred to the following formations: Potsdam, Lower Magnesian, Trenton and Galena, Hudson River, Niagara, Guelph, Lower Helderberg and Hamilton.

He recognizes *Triplesia*, *Holopea* and *Bellerophon*, and a second species of *Palæacmæa* in the Potsdam; and also *Ellipsocephalus* and the peculiar genus *Aglaspis*, of Hall, in the same formation, thus adding materially to our knowledge of the fauna of the Potsdam period, and to the previously known range of some of the genera mentioned. The Lower Magnesian epoch he finds represented in Wisconsin by the genera *Dikellocephalus*, *Illænurus*, *Metoptoma* and *Scævogyra*, the latter being a new genus of sinistral gasteropods. He also proposes a new genus of corals, *Cystostylus*, among the fossils of the Niagara group. His palæontological recognition of the Guelph limestone in Wisconsin, is important; and he also describes new forms from that formation. Some of the species recognized as new among the Wisconsin collections have been described by Prof. Whitfield in the published annual reports of that survey, but about thirty of them are published in the forthcoming volumes for the first time. These works of Prof. Whitfield, all of which are practically finished, will become an important part of the palæontological literature of our country.

The labors of Mr. S. H. Scudder in invertebrate palæontology are confined almost wholly to fossil insects, but he has performed this work so well, and prosecuted it so vigorously, that no one seems disposed to dispute the ground with him. He is still busily engaged with his great work on the Tertiary insects of North America, which is now well advanced toward completion, and is to form Vol. XIII of the quarto series of the U. S. Geological Survey of the Territories, lately in charge of Dr. Hayden. His memoir on the Palæozoic cockroaches has just issued in quarto form from the press of the Boston Society of Natural History, in which about sixty species are enumerated and figured. A memoir in the same form and from the same press, on Early Types of

Insects, has also lately issued, and an abstract of it has appeared in the January (1880) number of the *American Journal of Science and Arts*, pages 72-74. An interesting article from his pen has also lately appeared in the Report of Progress of the Geological Survey of Canada for 1877-1878, pages 175-185, on "The Fossil Insects collected in 1877 by Mr. G. M. Dawson in the interior of British Columbia." The insects described are all referred to the Tertiary period, and represent four orders; one species being referred to the Hymenoptera, two to the Diptera, ten to the Coleoptera and four to the Hemiptera. Among the latter he proposes the new genus *Planophlebia*.

The duties of Prof. A. Hyatt at the Museum of the Boston Society of Natural History, have made such demands upon his time for the past year, as to retard the progress of his special investigations. He is still working, however, upon the Ammonites, being now specially engaged upon the *Arietidæ*, and also upon the Steinheim shells. His only published work for the past year is embraced in a paper, by the writer of this article, on "Fossils of the Jura-trias of South-eastern Idaho," in the Bulletin of the U. S. Geological Survey of the Territories, Vol. v. Prof. Hyatt there proposes and diagnoses the new Cephalopod genus *Meekoceras*.

Mr. W. H. Dall published in the Proceedings of the U. S. National Museum, Vol. I, page 3, an interesting note on the occurrence of a Post-pliocene deposit containing recent species of marine shells in a semi-fossilized condition, at the head of a cañon near San Luis Rey, California, twelve miles from the sea and six hundred feet above tide water.

This determination of species is especially interesting and important, since it proves a considerable elevation of that coast to have taken place at a comparatively recent date. He also published in the same volume, pages 10-16, an article on "Fossil Molluscs of the Later Tertiary of California," describing six new species, and giving a table showing the known distribution of forms and the proportion of fossil and recent species respectively.

Mr. Angelo Heilprin has published in the Proceedings of the Academy of Natural Sciences at Philadelphia for 1879, three articles bearing respectively the following titles: "On some new Eocene Fossils from the Claiborne marine formation of Alabama;"

" A comparison of the Eocene Mollusca of South-eastern United States and Western Europe in relation to the determination of identical Forms," and " Stratigraphical evidence afforded by the Tertiary Fossils of the Peninsula of Maryland." The first of these papers is illustrated by a plate of figures; the other two embrace some important philosophical discussions. Mr. Heilprin has begun the preparation of a monograph of the Tertiary Fossils of Eastern North America.

George Jennings Hinde, Esq., F. G. S. of Surrey, England, published in the Quarterly Journal of the Geological Society for August, 1879, pages 352–369, an important memoir " On Conodonts from the Chazy and Cincinnati group of the Cambrosilurian, and from the Hamilton and Genesee Slate divisions of the Devonian in Canada and the United States." Palæontologists have been divided in opinion as to what class of animals these interesting remains belong to, and Mr. Hinde's important memoir still leaves us in doubt upon this point, although he has much enlarged our knowledge concerning the objects themselves.

In 1878 Mr. U. P. James began, at Cincinnati, the publication of *The Palæontologist*, for which he is thus far the only writer. Four numbers have been printed, aggregating thirty-two pages octavo, two numbers of which have appeared in 1879. In these two numbers Mr. James describes twenty-one new forms of Lower Silurian fossils, and proposes two new fucoid genera, *Saccophycus* and *Lockeia*.

Mr. Victor W. Lyon described three new forms of *Calceola* from the Upper Silurian rocks of Kentucky, in the Proceedings of the Academy of Natural Sciences at Philadelphia for 1879, pages 43–46.

Mr. S. A. Miller has, during the past year, published in pamphlet form, of thirty-five pages, a revision of his " Catalogue of Fossils found in the Hudson River, Utica Slate and Trenton groups, as exposed in the south-east part of Indiana, south-west part of Ohio and northern part of Kentucky," which originally appeared in the Tenth Annual Report of the Geological Survey of Indiana. In the April number of the Journal of the Cincinnati Society of Natural History, pages 31–42, he has " Remarks upon the Kaskaskia group, and descriptions of new species of Fossils from Pulaska county, Kentucky;" the new forms being illustrated, with others, upon the two plates which that number

contains. In the July number of the same journal, pages 104--118, Mr. Miller has "Descriptions of twelve new Fossil species, and remarks upon others." The species are from the Hudson River, Niagara and Upper Helderberg groups, all being echinoderms except one fucoid, and all are illustrated upon the two plates which accompany the number.

Prof. James M. Safford read a paper at the Saratoga meeting of the American Association for the Advancement of Science, on some remarkable Crinoids from Tennessee, which form the subject, in part, of the article by Prof. Hall in the lately published edition of the Twenty-eighth Regent's Report, and which has already been mentioned.

Mr. E. O. Ulrich has, in the April number of the Journal of the Cincinnati Society of Natural History, an illustrated article entitled "New genera and species of Fossils from the Lower Silurian about Cincinnati. He describes thirty-two species, and proposes three new genera, *Lepidolites*, *Ropalonaria* and *Crateripora*. In the October, 1879, number of that Journal, pages 119–134, he has two articles entitled, respectively, "Description of a new genus and some new species of Bryozoans from the Cincinnati Group;" and "Description of a Trilobite from the Niagara Group of Indiana," both being illustrated. He has also lately personally published a thirty-two page pamphlet, "Catalogue of Fossils occurring in the Cincinnati Group of Ohio, Indiana and Kentucky."

Lieut. A. W. Vogdes, in "Notes on the Geology of Catoosa county, Georgia," in the December number (1879) of the *American Journal of Science and Arts*, page 477, names and briefly characterizes *Calymene rostrata*, a new Upper Silurian trilobite.

Messrs. Charles Wachsmuth and Frank Springer have published, in the last number for 1879 of the Proceedings of the Academy of Natural Sciences of Philadelphia, a "Revision of the Palæocrinoidæ. Part 1. The families Ichthyocrinidæ and Cyathocrinidæ." Those who have done original work with the palæozoic crinoids, or attempted a critical study of them, can fully appreciate the importance of the work which has been undertaken by these authors. The portion now published is the first of a proposed series, and contains about one hundred and fifty pages and three plates of illustrations. It contains a discus-

sion of the general subject and of the questions pertaining to the two families now considered; a rearrangement of the genera and sub-genera under each, and lists of all the known species of each genus with their synonymy.

Mr. C. D. Walcott, in four pages printed in advance of the Thirty-second Annual Report of the New York State Museum of Natural History, publishes "Descriptions of new species of Fossils from the Calciferous formation," embracing five new forms. He has also published a pamphlet of thirty-eight pages and two plates, in advance of Vol. x, Transactions of the Albany Institute, with the triple title, "The Utica Slate and Related Formations; Fossils of the Utica Slate; and Metamorphosis of *Triarthrus becki.*" In these papers Mr. Walcott presents some interesting discussions, makes known important facts bearing upon the subjects indicated by the titles, and proposes the genera *Cyathophycus* and *Discophycus.* The Thirty-first Annual Report of the New York State Museum has lately been issued, which contains the final publication of Mr. Walcott's papers, "Notes on some sections of Trilobites from the Trenton limestone;" "Note upon the Eggs of the Trilobite," and "Descriptions of new species of Fossils from the Chazy and Trenton limestone." Mr. Walcott has also much important material in hand, which will, when published, add largely to our knowledge of the anatomy of the Trilobite.

In the January (1879) number of the Journal of the Cincinnati Society of Natural History, Prof. A. G. Wetherby has an article entitled, "Description of a new family and genus of Lower Silurean Crustacea," which is illustrated by eight figures on plate 7 in the April number of the same journal. The proposed new family and genus (*Enoploura*) are founded on the *Anomalocystites* (*Atelocystites*) *balanoides* of Meek, which Prof. Wetherby removes from the Cystidians, where it was placed by Meek, to the Crustacea. He also publishes in the April number of that journal, some interesting remarks upon the genus *Pterotocrinus* Lyon and Cassidy, with illustrations. He thinks the genus more nearly allied to *Eucalyptocrinus* than any other, and not nearly related to *Dichocrinus*, as has been formerly supposed by some palæontologists. In the October number, pages 134–140, Prof. Wetherby has "Descriptions of new species of Crinoids from the Kaskaskia group of the Sub-carboniferous," with one plate of illustrations. He has also in press, a revision of certain species of Crinoids which have been referred to the genus ***Zeacrinus.***

Professor A. Winchell has an investigation of the Cephalopods of Tennessee nearly completed, and is also pursuing his investigations of the Stromatoporidæ.

The writer of this article has published in Vol. v, of the Bulletin of the United States Geological Survey of the Territories, the three following "Palæontological Papers:" No. 9—"Fossils of the Jura-trias of South-eastern Idaho," pages 105–118; No. 10—"Conditions of Preservation of Invertebrate Fossils," pages 130–142, and No. 11—"Remarks upon certain Carboniferous Fossils from Colorado, Arizona, Idaho, Utah and Wyoming, and certain Cretaceous Corals from Colorado, together with descriptions of new Forms," pages 209–221. He has also in the same volume, pages 143–152, in connection with Prof. H. Alleyne Nicholson, a supplement to the Bibliography of North American Invertebrate Palæontology. The March number of the *American Journal of Science and Arts* also contains an article from his pen entitled, "Remarks on the Jura-trias of Western North America."

The most important of these papers is No. 9, relating to the discovery of Triassic types in the region indicated, the epoch of the Muschelkalk of Europe being fully recognized. It is in this paper that the new genus *Meekoceras* of Hyatt is diagnosed.

The writer has also in press a series of Contributions to Invertebrate Palæontology, seven in number, illustrated by thirty-eight lithograph plates. The first portion with ten plates has just been published separately, and is to appear in the Annual Report of the U. S. Geological Survey of the Territories for 1877, and the remainder in that for 1878. The fossils described and illustrated are from the following formations: Carboniferous, Triassic, Jurassic, Cretaceous, Laramie and Tertiary. A large proportion of these species have been described by the writer in different publications of the surveys, formerly in charge of Dr. Hayden and Prof. Powell respectively; a part are therein described for the first time, and the remainder are species that have, by different authors, been described in various publications, but not illustrated. These descriptions last referred to are mostly by the late Mr. F. B. Meek and Dr. B. F. Sherward. It has been the aim of the writer to illustrate all the species described by these two authors as well as others, so far as practicable; and when the volumes in question appear, there will remain comparatively

few described species from strata of the western half of our country that will not have been illustrated.

Besides the foregoing, the writer has also in press, for the Proceedings of the U. S. National Museum the following articles and notes: "Descriptions of new species of Carboniferous Invertebrate Fossils;" "Descriptions of new species of Cretaceous Fossils from Kansas and Texas;" "Note on the occurrence of *Productus giganteus* Martin, in California," and "Note on *Criocardium* and *Ethmocardium*." The three first-named papers are illustrated by seven plates of figures. In the first paper is proposed the new Crinoid genus *Lecythiocrinus*, from the Upper Coal measures of Kansas. In the second, two species are described from the Dakota beds of Kansas, collected by the late Prof. Mudge, adding to our knowledge of the fauna there, which links the lower American Cretaceous with the upper much more closely than was formerly supposed. The discovery of that huge brachiopod, *Productus giganteus*, in the western part of the continent, where it has hitherto been unknown within its limits, is an interesting fact. The sub-genus *Ethmocardium* is proposed in the last-named paper for a *Cardium* (*C. speciosum* Meek and Hayden), which is without spinules, and has rows of cleanly-cut holes through the entire thickness of the test, which occupy the spaces between the ribs of the middle portion of the shell.

Among the many important facts brought out in the "Contributions," it is there shown that many of the types by which the living North American land and fresh-water molluscan fauna is characterized, have descended to us almost entirely unchanged from the Laramie period and, in some cases at least, from the still earlier Cretaceous epochs. Even some of the sub-divisions of genera, made by different authors, and which some others have been slow to accept, as insufficiently founded, are found to have become established in those early times, and to have maintained their slightly differentiated status intact during the intervening epochs. It also appears that the nearest relatives, and doubtless the lineal descendants of the Laramie and Tertiary fresh-water and land mollusca are found living in the fluvatile waters and drainage areas of the Mexican gulf and Arctic ocean, and not upon the Pacific slope. Some exceedingly interesting zoölogical questions are thus suggested.

No investigation of living forms has a more direct bearing

upon invertebrate palæontology than that of the Brachiopoda. For this reason mention should be made here of a memoir by Prof. W. K. Brooks, on the "Development of *Lingula* and the systematic position of the Brachiopods," published in Scientific Results for 1878, Chesapeake Zoölogical Laboratory, Johns Hopkins University, Baltimore, 1879. Prof. Brooks opposes the views so long and ably advocated by Prof. Morse, that the Brachiopoda are specialized worms, and presents his reasons for regarding them as more nearly related to the Polyzoans.

The foregoing notes, so far as is known, embrace all the publications that come within the scope of this article. There are, doubtless, other works in progress whose authors are waiting suitable opportunity to pursue their investigations. Prof. A. R. Grote has some uncompleted and unpublished notes on a new form of the remarkable crustacean genus *Eusarcus* Grote and Pitt, in the Waterlime group of Western New York. Prof. Verrill has also in hand the few fossils that were dredged from the submerged Tertiary beds off the north-eastern coast, but nothing has been published concerning the fauna of this Tertiary Atlantis since his article of last year in the *American Journal of Science and Arts.*

It has often been a subject of remark during the past few years that invertebrate palæontology was receiving comparatively little attention in the United States, but the foregoing makes a very satisfactory showing for the past year. The excellent character also of much of the work that is being done by the younger palæontologists promises well for the future.

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A REVIEW OF THE MODERN DOCTRINE OF EVOLUTION.—CONCLUDED.[1]

BY E. D. COPE.

III. Metaphysics of Evolution.

I ENTER here upon a wide field, over which I can only skim on an occasion like the present. The subject has been already introduced by reference to consciousness as modifying

[1] A lecture delivered before the California Academy of Science, Oct. 27, 1879.

movement; of course then if movement modify structure, the latter is influenced by consciousness. The word consciousness was then, and is now, used in its simplest sense, viz: as synonymous with physical sensibility. Its lowest and most usual exhibition is the sense of touch; the special senses, taste, sight, etc., are higher forms, while thoughts and desires are organized products of the same raw material. Consciousness cannot be denied to many of the inferior animals; indeed, if we grant it to any, we must admit that it is displayed at times by even the lowest *Protozoön.* That these humble creatures should possess it, is apparently quite as probable as that the very similar bioplasts of the brain of man should be its seat.

Consciousness alone is not a sufficient basis for the development of mind. For this, one more element is necessary, and that is, *memory.* Impressions made by the environment are registered, and soon cease to be present in consciousness. Under the influence of association the impressions return to consciousness. Associations are those of place, of the order of time, and of similarity or difference in various qualities, as size, color or any other physical features. Experiences of these qualities are to all conscious beings either painful, indifferent or pleasurable. When association requires, events, objects or characteristics, are returned to consciousness in the order in which they cohere most firmly in the mind, which may or may not be that in which they entered it. The liking for or dislike to the object, are equivalent to an attraction to or repulsion from it. Thus experience is begotten: as its material increases, new combinations are formed, new relations observed, and in the highest types of mind, laws are discovered. No one can deny memory to animals; it is the medium of their education by man, and has been as well the means of their education by nature. Impressions cause a rearrangement of certain elements of structure which give the form to consciousness when it arises again. It is also probable that these arrangements are not the same as those which represent classifications and conclusions, but that nevertheless the arrangement or organization of these is determined by the simpler arrangements caused by perceptive stimuli. Experience produces these combinations in the bioplastic aggregations of all animals, be they in the form of ganglia, brains, or less specialized forms. Nowhere in the human organism are the effects of effort and use so strikingly wi[illegible]ssed as

in the increase of brain power; and familiarity with the education of the lower animals shows that this is the case with them also, though in a lesser degree than in man.

If, then, we grant the propositions, first, that effort and use modify structure; and second, that effort and use are determined by mind in direct ratio to its development, we are led to the conclusion that evolution is an outgrowth of mind, and that mind is the parent of the forms of living nature. This is, however, to reverse a very usual evolutionary hypothesis, viz: that mind is the product and highest development of the universe of matter and force. The contradiction is, however, not so absolute as at first appears. By mind, as the author of the organic world, I mean only the two elements, consciousness and memory. But it is the view of some thinkers that consciousness is a product; that it is not only a correlative of force, but a kind of force. To the latter theory I cannot subscribe; when it becomes possible to metamorphose music into potatoes, mathematics into mountains, and natural history into brown paper, then we can identify consciousness with force. The nature of consciousness is such as to distinguish it from all other thinkable things, and it must be ranged with matter and force as the third element of the universe.

It is true that unconsciousness does not imply absence of life as generally understood. A majority of the processes of life are performed unconsciously by living creatures; mind itself being no exception to this rule. There is another class of acts whose performance produces sensation, but consciousness is not concerned in them as an immediate cause. Therefore, it is a common endeavor to associate reflex and unconscious acts with the molecular movements of inorganic and non-living substances. But the one great difficulty in making this identification has never been surmounted. This is the different nature of the movements in the two cases. In non-living matter they are simply polar, nothing more. In living beings they display design. Perhaps I use the word "design" in a new sense, but the expression is nevertheless appropriate. What I mean is, that the movements of living things have direct reference to consciousness, to the satisfaction of pleasures, and to the avoidance of pains. The *molecular* movements within animals of the simplest class are the digestion of food and the elaboration of the materials of repro-

duction. The *molar* movements of the simplest animals are to enable them to escape the pains of hunger and celibacy. Moreover there is reason why the movements of living beings display design. We all know the nature of habits; how they are performed unconsciously, and as automatically as digestion itself. But did any one ever know of a habit in an animal, whose origin he could trace, which has been formed in unconsciousness? According to our knowledge, habits are always the result of stimuli which are consciously felt, and which cause by repetition or through reminiscence a repetition of the resulting movement. After a sufficient number of repetitions such an act becomes a habit, *i.e.*, is performed automatically, or without the intervention of effort, and frequently without consciousness. It thus becomes a part of the character of the individual or species. This common phenomenon is explained by the hypothesis, that an organization of the centers controlling action is caused by the efforts of the animal under the stimulus, and that finally a machine is constructed which determines the nature of the force expended, without further mental exertion of the individual. Such a process is education, and the result is an addition to the stock of faculties already on hand. Thus is explained the vast number of automatic and unconscious activities displayed by animals; to the same source, I believe, the common reflex acts may be traced; it even appears to me probable that the organic functions in general have had the same origin.[1] While these latter have mostly long since passed beyond the control of the mind, portions of the urogenital functions still linger within the confines of its jurisdiction. Thus have consciousness and mind endowed living nature with useful functions; and this, which may be called the *Theory of Endowment*, accounts for the element of design which is so puzzling when seen in unconscious and reflex acts.

As it has been maintained above, that structure is the effect of the control over matter exercised by mind, it is evident that the evolution of mind must be directly followed by corresponding development of organism. The science of palæontology substantiates this theory in a wonderful manner. But the animal mind being generally occupied with simple functions, its expressions in structure are usually nothing more than the progressive creation of improved instruments for obtaining food, resisting

[1] Consciousness in Evolution. *Penn Monthly*, 1875.

climate, escaping enemies, and reproducing their kind. The struggles of animals have been on this platform, and mind has only been necessary to aid in accomplishing the ends above mentioned. Wonderfully effective machines for grinding, cutting, seizing and digging; for running, swimming and flying have been produced. The development of mind proper must appear in the size and structure of the brain; and though the history of the latter in past ages must always remain, in large part, hidden from us, it is known that in the former respect there has been great progress made in various lines of animals. Now the line which has carried brain to its present development in man, the *Quadrumana*, has been deficient in special mechanical excellencies of the kind enumerated above. Perhaps primitive inferiority in these many respects has kept the *Quadrumana* under greater mental tension, and compelled them to exercise caution in their acts and give that opportunity to thought which was less demanded in the case of other animals. Furthermore, if they are less specialized in their mechanism than most other *Mammalia*, they are less restricted by it to peculiar modes of life. They are more versatile, and more capable of the adoption of new habits as a consequence. And here we have a glimpse of a most important principle in evolution, which is the keynote to its method; this is what I have called *The Doctrine of the Unspecialized.*

Palæontology shows that the succession of living types has not been in a single straight line. It has been in many divergent lines, and a large number of them have not continued to the present time. The history of life has been well compared to a tree with divergent branches, many of which do not reach the elevation of the summit. Furthermore, in the many cases in which we can trace the lower lines to the present period, it is evident that in their present condition they could not have given rise to the higher forms. Each line, in fact, has developed to an extreme of specialization of structure, which it would seem is incapable of modification in any direction very divergent from that which it has already taken. Much less have such specialized types been able to survive the environment for which they were designed; with important changes in that respect they have perished. A few examples will serve to illustrate my meaning. The direction of development has been from fishes, through *Batrachia* and reptiles, to birds and mammals. But we cannot

derive any living type from the osseous fishes of the present or past ages (*Hyopomata*): to find the origin of *Batrachia*, we must pass below these to more generalized and older forms, the *Dipnoi*, a class whose position in the system was for years a controverted point. We cannot obtain *Mammalia* from any of the existing types of reptiles, but we must go back to the Permian period, and trace their outlines in the *Theromorpha* of that day. In spite of the prophetic resemblance of these remarkable animals, they are inferior to later Reptilia in the structure of their vertebral column, and display resemblance to some of their immature stages, as well as to those of the *Mammalia*. Among mammals we cannot derive monkeys from *Carnivora* or *Ungulata*, nor the latter from each other, but can only trace their close approximation in the Bunotherian types of the Lower Eocene. So with the great divisions of *Ungulata; Proboscidians*, *Hyrax*, and the even and odd-toed orders must all be traced to the unspecialized *Amblypoda*, with small brains and five-toed plantigrade feet, as their ancestors.[1] It is easy to perceive that the generalization and plasticity of all these forms has furnished the ground of their ancestral relation.

We are now in a position to comprehend more clearly the general nature of evolution. The doctrine of the unspecialized teaches that the perfection produced by each successive age has not been the source or parent of future perfection. The types which have displayed the most specialized mechanism have either passed away, or, undergoing no change, have witnessed the progress and ultimate supremacy of those who were once their inferiors. This is largely true of animals which have attained great bulk. Like those with perfected weapons, they have ever been superior to the attacks of other animals in their day, and doubtless led, so long as food abounded, lives of luxurious indolence. With change or diminution of food, such huge beasts would be the first to succumb, and it is a fact that no type of land animals has maintained great size through many geologic changes. It is true that all of the lines of ancestry of the existing higher *Mammalia*, as the subdivisions of the *Carnivora*, *Ungulata* and *Quadrumana*, which we know in detail, commenced with types of small size and correspondingly little muscular power.

Some important conclusions may be derived from what has

[1] See the origin of types of *Mammalia educabilia*, Journal Academy, Philadelphia, 1874. This view was subsequently expressed by Huxley.

preceded. It seems that evolution has witnessed a continual running down of types to their great specialization or extinction. That many types have arisen in weak and small beginnings, but that the conflict with more powerful forms has developed some qualities in which they sooner or later excelled, and which formed the basis of their future superiority and persistence. That while this has probably been the true cause of the origin of the many admirable mechanical adaptations displayed by animals, it is preeminently true of the development of mind. That the reason why progress has reached its limit in the lines of greatest specialization, has probably been the removal of the occasion of its original cause, *i. e.*, active exercise in the struggle for existence. This explanation is suggested by the remarkable degradation which is witnessed in animals whose mode of life relieves them from the necessity of working for a livelihood, *e. g.*, the parasites and sessile animals whose young are free. Some of these creatures, on assuming their parasitic life, lose the semblance of even the order to which their young belong. The primary stages of various plants move actively through the water like the lowest forms of animals, and their sessile adult condition must be looked upon as a degeneration. It is well known that the endeavor to relegate the lowest forms of life to the two kingdoms of animal and vegetable, has been generally abandoned. The great vegetable kingdom probably exhibits a life degraded from more animal-like beginnings. Animal irritability and mobility have been lost, and their own consciousness must be entirely eliminated from the question of the origin of the many later and specialized types of plants. But I venture here the hypothesis that the consciousness of plant-using animals, as insects, has played a most important part in modifying the structure of the organs of fructification in the vegetable kingdom. Certain it is that insects have been effective agents in the preservation of certain forms of plants. I would suggest whether the mutilations and strains they have for long periods inflicted on the flowering organs, may not, as in some similar cases in the animal kingdom, have *originated* peculiarities of structure.

Evolution of living types is then a succession of elevations of platforms on which succeeding ones have built. The history of one horizon of life is, that its own completion but prepares the way of a higher one, furnishing the latter with conditions of a

still further development. Thus the vegetable kingdom died, so to speak, that the animal kingdom might live; having descended from an animal stage to subserve the function of food for animals. The successive types of animals have first stimulated the development of the most susceptible to the conflict of the struggle for existence, and afterwards furnished them with food. Doubtless in the occupation of the world's fields, the easiest and nearest at hand have been first occupied, and successively those which were more difficult. The digging animals are generally those which first abandoned the open field to more courageous or stronger rivals; and they remain to this day generally of low type compared with others of their classes (*e. g.*, *Monotremata*, *Rodentia*, *Insectivora*). All occupations have been filled before that one which requires the greatest expenditure of energy, *i. e.*, mental activity. But all other modes of life have fallen short of this one in giving the supremacy over nature.

Automatism then represents a condition of "lapsed intelligence" and diminished life. The unconscious automatism of animals is a condition of still greater lapse. On the contrary, sensibility is the condition of development, and the susceptibility and impressibility which is the extreme reverse of automatism is the especial character of youth. Here the "doctrine of the unspecialized" finds justification again.

What the future has in store for us in the history of inorganic force and its results, we can not now foresee, but I call attention in this connection to the important part played by life in the distribution of minerals. It has long been known that the carbon of the earth's crust was once in a living state, and it is admitted that the limestone once circulated in the fluids of animals. We have recently been compelled to believe that siliceous rocks are composed of the consolidated shells of minute plants, which they have elaborated from the water of the ocean. Silver and gold are segregated and deposited by seaweeds. The principal rock material, whose relation to life has not been ascertained, is alumina. How far the processes which now characterize dead matter were once related to life is a problem for the future.

IV. The Morals of Evolution.

The doctrines of the struggle for existence and survival of the fit in human life, have a two-fold application. The relative pro-

portions in which these applications are made, will depend on the moral development of him who makes them. Moral density and intelluctual stupidity (often nearly allied) will see in these two laws only the struggle for material power, and the survival of the strongest. They will hardly urge in these days, as they would infallibly have done had they lived a few centuries ago, that the strongest means the hardest hitter, or the most successful assassin, but they will probably believe that this pre-eminent position belongs to the most wealthy. From a purely dynamical standpoint this position is correct, yet it might be a useful question for such advocates to consider why it is that physical oppression and assassination should be less successful avenues to power than they once were.

There are two reasons why man does not grant the first place in his esteem to physical force. The first principles of morals are acquired in the struggle for existence. The idea of *meum* and *tuum* was speedily developed so soon as men associated together; and the habit of justice has doubtless been formed by the insistence of every man on his own rights, and by the power of combinations of men to control those who may from superior strength or other cause seek to violate the rights of property. Thus law originated, and from the earliest history of the race to the present day it has educated the barbarous and semi-barbarous to civilization. It is then easy to perceive that man gives the highest place in his affections to the *most just;* but there is yet another reason why this should be the case.

The reproductive instinct in the lower animals has developed into social affections, and these form a part of the character of the higher animals and, in an especial degree, of man. The sentiments of sympathy and benevolence are probably outgrowths of the same. While the rational faculties are concerned in the *knowledge* of right, these sentiments are a source of the *love* of right. This disposition is trusted by men as leading to the *practice* of right, in cases where the power to enforce it is not immediately present. The struggle for existence then among men ranges all the way from a rivalry of physical force to a rivalry for the possession of human esteem and affection. The robber and assassin of the lowest human races are represented by the slanderer and defamer in the higher. The ultimate prosperity of the just, asserted and foretold by prophets and poets, is but a forecast of the doctrine of the survival of the fittest. The unjust are sooner

or later eliminated by men from their society, either by death, seclusion or ostracism.

But the organized moral qualities cannot normally transcend in power, as motives of human action, those which secure his physical preservation. Lines of men in whom the sympathetic and generous qualities predominate over the self-preservative, must inevitably become extinct. Evolution can produce no higher development of the race (whatever may sometimes appear in individuals), than an equivalency in these two classes of forces. Beyond this the organization of the social faculities of the brain must always be repressed in the race, so that we can only expect to attain an equilibrium between them and the more purely selfish ones, as the very highest result of unassisted evolution. In this position the judgment is suspended between the opposing classes of motives; and it must ever remain doubtful in general as to whether resulting action will be just and right, or the reverse. I exclude from this question those generous acts which do not appear to the actor to conflict with self-interest. These may be termed *sympathetic* acts, and are quite distinct from the altruistic.[1] The sympathetic actions are seen at times in most animals. The altruistic acts, on the other hand, are those that express what is usually called "moral principle." Such acts may often coincide with the interest of the actor, but so long as they do not appear to him to do so, they are altruistic. It is part of the doctrine of evolution, that habits will ultimately disappear on the removal of their stimulating cause. The moral nature originated, and has been maintained, through the pressure of the fear of consequences. The removal of this pressure, through the acquisition of power, would then ultimately result in the diminution or loss of the moral nature, through disuse. The abuses of power are well known. This appears to be all that evolution can do for us in the production of the moral nature. So it would appear that no organized faculty of *self-sufficient altruistic justice* can be derived by the process of mental evolution. The result is rather a continued struggle between justice and injustice. It is, then, evident that any power which shall cause the permanent predominance of the just over the selfish faculties must be derived from without.

After we omit from customary religion, cosmogony, which belongs to science, and theogony, which belongs to the imagination, we have left an art which has for its object the development

[1] On the Origin of the Will. *Penn Monthly*, 1877.

and sustentation of good works or morals among men. If the teachers and professors of this art produce the results in this direction at which they aim, their great utility must be conceded by all. Their method has the advantage over that of the law, in being of the character of inducements supplied before action, instead of pains and penalties inflicted after action. They strive to *originate* good conduct, rather than to punish bad conduct. They are working on the side of the *originative* force in development, rather than the destructive; the "*origin of the fittest,*" rather than the "*survival of the fittest.*" Whether man possesses the spontaneous power called "free will" or not, the work of supplying inducements for good conduct is most useful to society. But religion, as generally understood, pre-supposes free will; and the definition of the word responsibility implies its existence. The question as to the presence of such a faculty is an interesting one, and will now be briefly considered.

The well-known doctrine of necessity leaves no place for free will. All acts are the consequences of motives, and are the outcome of a balancing of interests. The heaviest side of the account determines action. Our physical necessities supply the motives for most of our activities; our pursuit of food and clothing is of necessity, and no condition is free from it. Evolution supports and explains this doctrine, as can readily be perceived. It derives our instincts from an ancestry whose daily occupation has been their gratification. But it has been shown above that this development does not supply the motives of an independent morality.[1]

The direction of action under stimulus is determined by intelligence, which is, as has been above maintained, the product of experience. Intelligence is organized or classified knowledge, and directs the activities set on foot by the likes and dislikes, that is, the affections. *When there is knowledge, there is no necessity for spontaneous action or free will,* since action is determined by the organization of the mind. Even if the mind is conscious of insufficient knowledge, an inducement to seek knowledge is supplied, and according to the result of investigation will be the direction of knowledge.

But we are here brought to face the case where knowledge cannot be or is not obtained. This is the condition of the two

[1] On the Origin of the Will. *Penn Monthly*, 1877.

questions of the practice of morals, and the nature of the future life. The evolution of mind consists of a continual advance from the known into the unknown, and a transfer of the unknown to the known. So long as there is any inducement to progress of this kind, and nature responds to inquiry, development will go on. Although it is true that it is only among men, and but few men at that, that the pursuit of knowledge is an occupation; most men add to their stock incidentally as they pursue other avocations. The knowledge of right and the inducements to its practice are learned in their every-day intercourse, so far as it can be acquired. But knowledge in these directions soon attains its limit, and accordingly, development dependent on knowledge must cease. If any further progress in practical morals is to be made, some new force must intervene at this point.

Here is the opportunity for the appearance of will or spontaneity; here it is at least needed. I am willing to believe that it may appear at this point, and that so long as we have to face the unknown in moral progress, so long it will remain. As a force it must be equivalent of other forces, but as a form of consciousness it is a new element of mind. As represented in new molecular organization, it may always continue, even after much of the unknown may have been conquered, and a stationary period may have ensued. Such an accession to character would be a fitting crown of evolution, and a justification of this labor of the ages. If a true factor in human development, it might be compared, in the creation of character, to the apical bud of a growing tree. As the part preëminently living, it leads the growth of the trunk and branches. They all follow of necessity the path it has marked out. Under its lead they are successively formed, become fixed, and finally decay.

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THE TONGUE OF THE HONEY BEE.

BY PROF. A. J. COOK.

THE bee is, and has long been, of great importance to the commercial world, and this, together with the fascination inseparable from its study, have led many of the ablest scientists to carefully investigate its structure and habits. Yet I know not if there exists to-day an accurate description of a bee's tongue, and the method by which the insect procures its food.

The literature of the subject abounds in confusion and inac-

curacy. The most learned scientists, those usually the most careful and accurate, like Reaumur, Newport and Carpenter, give voice to palpable errors. Even the last edition of the Encyclopædia Britannica gives further life to these old erroneous views. Let us give brief attention to some of these descriptions.

Hogg says the bee's tongue is cylindrical; Kirby, Spence and Neighbour state that it is flat; Reaumur and Chambers that it is between the two. Reaumur, Newport, Kirby, Spence, Carpenter, Shuckard, Bevan and Hunter all state that the tongue is solid, and that the honey is sopped up, or taken through a tube, formed by the close approximation of the maxillæ, labium, and labial palpi. Newport speaks of a hairy sheath along the under side of the basal two-thirds of the organ. Neighbour says there is a gutter throughout the entire length of the tongue, while Swammerdam, Lamarck, Burmeister, Wildman and Munn claim that the organ is tubular. Newport and Carpenter assert that the bee's tongue is muscular, which is denied by Cuvier, Reaumur and Chambers.

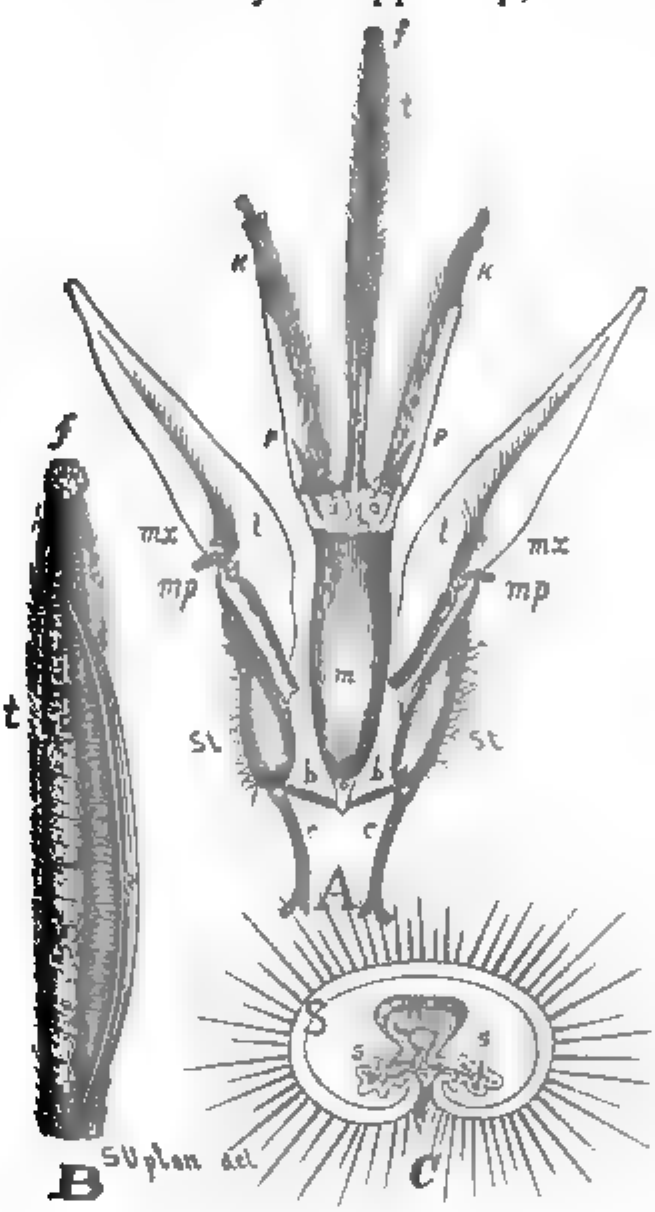

FIG. 1.—Tongues of the Bee.

That bees lap the nectar is affirmed by Reaumur, Newport, Kirby and Spence, Savigny, Carpenter, Bevan and Hunter; while Swammerdam, Wildman, Lamarck, Burmeister, Munn and Neighbour claim that the bees take liquids by suction.

Amid these conflicting views let us see if we may find the truth. To do this we must examine closely the structure of the organ, and also watch the insect as it is taking its fill of honey or some other liquid.

In the April number of the Journal of the Cincinnati Society

of Natural History, for 1878, Mr. V. T. Chambers, an able entomologist of Covington, Kentucky, published a very admirable paper upon this subject. In the American Quarterly Microscopical Journal for 1879, p. 287, the subject was again presented in a beautifully illustrated article by Mr. J. D. Hyatt, President of the New York Microscopical Society. I learn that Wolff has published a fully illustrated memoir on the anatomy of the honey-bee which, I regret to say, I have not seen. From Messrs. Chambers and Hyatt's papers, and my own researches and observations, I am able to present the following facts:

The mouth-parts of the honey-bee brought into requisition when the insect takes a liquid into its pharynx, are the maxillæ and the labium.

The maxillæ or second jaws (see *m x* in Fig 1, A) are situated each side of the labium. They are hinged to the head by the strong cardos (see *c c* in Fig. A) which are chitinous rods. Extending forward from the cardo is the more flattened stipes (see *st*, *st* in Fig. A) which is also mainly chitinous. From the stipes projects the triangular, deeply grooved lacinia (see *l*, *l* in Fig. 1, A). This is more membranous, but it is strengthened by a ridge of chitine which extends to the apex. At the base the very rudimentary maxillary palpi (see *mp*, *mp* in Fig. 1, A) are visible, while scattering hairs project from the inner margins. When the maxillæ are brought close together a tube is formed, which is continued by aid of a colorless membrane to the opening into the pharynx. Huxley
This opening is beneath the labium and between the mandibles. Invertebrates 369
The colorless membrane is continuous with the epipharynx. The muscles which move the maxillæ are attached mainly to the cardo and stipes.

The labium or lower lip of the worker honey-bee is from twenty-three to twenty-seven hundredths of an inch long. It consists of a central portion, and two pairs of appendages, the paraglossæ (see *p*, *p* in Fig. 1, A) and the labial palpi (see *k*, *k* in Fig. 1, A). The central portion is divided into a basal two-sevenths, or mentum (see *m* in Fig. A) and the terminal five-sevenths or ligula (see *t* in Fig. 1, A and B). The mentum is about seven-hundredths of an inch long. It is hinged to the sub-mentum (see *o* in Fig. 1, A) which in turn is hinged to the maxillæ by two chitinous rods (see *b*, *b* in Fig. 1, A). These rods permit free motion,

and to them are attached muscles, which in part affect the movement of the labium. The mentum is a flattened cylinder, the floor and sides of which are thick and opaque, because of the abundance of chitine contained in their structure. While lining this chitinous gutter and completing the tube is a thin colorless membrane, which is but the anterior prolongation of the pharynx. There also abundant muscles within the mentum which extend even for a short distance along the sides of the base of the tongue. These not only affect the motion of the whole labium, but also protrude and retract the ligula or tongue.

The ligula or tongue (Fig. 1, A and B, *t*) extends from the anterior extremity of the mentum. It consists of a sheath (Fig. B, *s*) which from the many rows of yellowish hairs appears annulated. When not distended, the sheath, as seen in cross-section (Fig. 1, C), is kidney-shaped. It has a slit (Fig. 1, C, *h*) along the under surface, from the base very near the end. In some specimens the slit seems to reach quite the end. Within the sheath is a small colored, triangular rod (Fig. 1, C, R) darker than the sheath, which except for a slit (Fig. 1, C, *h*) on its under surface, would form a tube Fig. 1, C, R); in fact the sides of the rod along the slit can be brought in such close contact as virtually to form a tube. Fine hairs project from the walls either side the slit (Fig. 1, C, *h*) into the tube, which doubtless aid in making the tube more perfect. Along the back of the rod is a conspicuous layer which Mr. Hyatt asserts is muscular. If this be so we can readily see how its action would spread the walls and open the slit. The rod projects beyond the sheath, as an imperfect funnel, the " button " of Reaumur (Fig. 1, A. and B, *f*). The wanting section of the funnel harmonizes with the slit in the rod. Near the end, the rod seems firmly attached to the sheath. Any attempt to draw the rod from this position is quite certain to rupture the sheath. The rod when extended projects from sixteen to eighteen-hundredths of an inch beyond the mentum. At the base the rod is colorless, and its tube connects above with the membranous sack next to be described, and through this with the tube of the mentum and with the pharynx.

Attached to the edges of the sheath, next to the slit, and possibly, as Mr. Chambers thinks, entirely lining the latter, and also to the corresponding edges of the tubular rod is a thin membrane (Fig. 1, C, *s*). Mr. Chambers thinks this passes over the slit in the rod, making the tube of the latter complete. I have reasons to

think he is mistaken, as will appear in the sequel. When not distended this membrane lies in folds (Fig. 1, C, *s*); but when distended it with the rod pushes out of the sheath, so as to form with the latter a large tubular sack (Fig. B S, *s*), with the tubular rod (Fig. C, R) along the surface opposite the sheath. At the base this sack has a chitinous support (Fig. A, Q Q), and connects through the tube of the mentum with the pharynx, and receives the tube of the rod. It extends nearly if not quite to the end of the sheath, certainly as far as the slit in the latter extends, and is, anteriorly, imperforate.

The labial palpi (Fig. 1, A, *k*, *k*) like the maxillæ, are deeply grooved, and when brought close together form a tube which also has a membranous connection with the mouth opening into the pharynx.

The paraglossæ are short, leaf-like organs (Fig. 1, A, *p*, *p*) with a hollow membranous base, which also connects with the tube of the mentum and the sack of the ligula.

When not in use the ligula, with the labial palpi and maxillæ, all double back under the head, and the tongue is so retracted that it extends no further than the labial palpi. This shortening of the ligula seems to be effected by drawing the more membranous and less hairy base into the mentum.

How do bees take liquids into their stomachs? This question, as we have seen, has received various answers. Some have thought that the nectar was drawn through a tube formed by the approximation of the ligula, the palpi and the maxillæ. Others that suction was the force and the tongue the tube. Still others have believed that the nectar was lapped up by the bees. I hope to be able to show you that all are right.

Look at the bee through a good lens (I have used Toll's one-half inch) while sipping honey containing grains of solid matter, and the fine particles will often be seen to ascend through the tube formed by bringing the maxillæ together. We have already seen how this liquid passes to the mouth and through this into the pharynx. Or we can color some rather thin honey or syrup by aniline (I have found deep red to be the best), and while the bee is sipping this colored liquid, which it does as eagerly as though the poisonous aliline were not present, cut off its head, which, with a pair of dissecting scissors is done in an instant. Examination plainly shows the track along the channeled maxillæ

and palpi, even to the mouth, which clearly reveals the path of the liquid. These conduits are much the larger approach to the pharynx; thus we see why bees take honey so fast when they can get freely at a large quantity, and why a few days of good basswood harvest are so fruitful.

Bees as surely take honey through the triangular rod which is enclosed within the sheath. I have proved this in several ways as follows:

I have placed honey in fine glass tubes and behind fine wire gauze, so that the bees could just reach it with the funnel at the end of the rod. So long as they could reach it with the funnel so long would it disappear. I have held the bee in my hand, by grasping the wings, while observing it with a good lens. I would gradually withdraw it from the drop of honey, which it would sip so long as the drop was within reach of the funnel. I have in such cases seen the red axis when the bee was sipping colored syrup. Subsequent examination by dissection revealed the red liquid still in the tube of the rod, clearly showing its course in passing to the pharynx. If we place the tongue with a drop of water on a glass slide and cover with a thin glass, and then look at it through the compound microscope, with a magnifying power of eighty diameters, we can readily see the liquid pass back and forth in the tube as we press with a pencil on the thin glass cover. As Mr. Chambers states, this tube at the base of the funnel is only one five-hundredth of an inch in diameter. We now understand why bees are so long in loading their stomachs when gathering from small tubular flowers, as then this minute tube is the only avenue by which the bee secures the nectar. We can also well understand why they gather so much faster from some flowers than from others. In the one case they secure the liquid sweet through both the channels above described, in the other, when the honey is scarce or deep down in small tubular flowers, they can only use this microscopic tube.

We also note the admirable construction of the tongue, which permits it to probe these tiny flowers, and also see the advantage of even a little additional length in this important and wonderful organ.

I also believe that bees lap up the honey. If we spread a thin layer of honey on a glass, and permit the bees to visit it, we shall see the bees wipe it up with their ligulæ. Fine drops dis-

appear even though the funnel does not touch them. From this observation, as well as the structure of the organ—if I am right in believing that the slit in the rod opens on the surface—we can but conclude that the slit in the rod, no less than the funnel, may be the door whereby liquids pass to the tube. If Mr. Hyatt is right in thinking that the dorsal band of the rod is muscular, we can readily see from its position and the form of the rod, how the slit might be opened. If the liquid is very thick the bees are seen frequently to retract the ligula and then extend it, as if to clear the organ by scraping it between the maxillæ and palpi.

While sipping honey the bee performs a kind of respiratory movement with the abdomen. This shows that the force of suction comes partly, if not wholly from the stomach, which organ is situated in the abdominal cavity. The tongue is also retracted and extended rythmically while the bee is sipping. The tip passes alternately back and forth from its greatest distance from the mentum to the end of the palpi. This movement may be something analogous to swallowing.

I am not certain as to the function of the membranous sack. I have found that if I killed a bee by compressing its thorax, very soon after it commenced to sip the colored liquid, that the latter was always in the stomach but not in the sack. If I waited longer I found the sack also partially filled. This leads me to conclude that it acts as a storehouse, enabling the bee to carry a load beyond the capacity of its stomach. It also appears glandular, when distended, so possibly it secretes an animal juice or ferment which aids in changing cane sugar into glucose or grape sugar; for we find upon analysis that pure cane sugar after passing through the stomach of the bee has partially undergone this transformation.

After the bees have sipped the colored liquid, I find invariably that the tip of the tongue—the small portion where the slit in the sheath seems obscure, and where the rod seems more firmly attached to the sheath, is highly colored, as though full of liquid. Possibly the sac does not extend into this portion, and the tube may be larger in this part. By a little pressure the liquid is made to pass out of this portion of the tube, either through the funnel or slit, perhaps both.

I have measured hundreds of tongues, under the microscope, with the camera lucida, and have been much interested to observe

the wondrous uniformity in length where the bees were from the same colony or from the same apiary, especially if close breeding had been practiced. Tongue after tongue would show a variation of less than .025 of an inch. I have found the length of the American black bee's tongue to average about .24 of an inch in length, from the base of the mentum to the tip of the ligula. American-bred Italian bees I have found, when measured by the same scale, to have tongues .02 of an inch longer. Some bees, said to be Cyprians, but closely resembling our black bees, except that the down on the thorax was a little more yellow, I have found to possess tongues a little shorter than those of our American Italians, though the average is but very little less. I have examined bees' tongues from workers reared from two different imported Italian queens, and found that in both cases they exceeded in length those of our American-bred bees, though the difference is very slight.

In 1878 I measured the tongues of some bees sent me for Cyprians. The bees were very yellow and beautiful. I found them to possess the longest tongues I have ever met, but there was very great variation. I had but few bees and sent for more, which never came. I had arranged the present season for bees of the various European races, and had been promised specimens, but greatly to my regret and disappointment, the bees have failed to come, so I have to make this but a partial report.

That the added length is of practical importance I have proved as follows: Honey in a vessel covered with fine gauze was placed before Italians till they ceased to eat because the honey was beyond reach. The vessel was then placed before black bees, which failed to reach the fluid. The vessel was then filled and given first to the black bees, which worked till the liquid was inaccessible, when it was placed before Italians. These would invariably commence to sip the honey. Again, a box one-half inch deep, without top or bottom, was covered with fine gauze having fifteen meshes to the inch. A glass was then placed in the box so inclined that while one end rested against the gauze the other was one-half inch from it. The glass was thinly spread with honey on the side next the gauze. This was placed in a hive of Italians, when the glass was cleaned of honey for a distance of twenty-four meshes from the edge where the glass rested on the gauze. The black bees could only reach and only

cleaned for nineteen meshes. Many trials gave the same result. This then shows why Italians can gather, and often do collect from flowers which fail utterly to attract the black bees. The nectar is beyond their reach.

It would seem from the above that American-bred bees have shorter tongues than those direct from Italy. It seems very probable that "natural selection," the very law which raised the Italians to their position of superiority, also gave to them their longer tongues. Shut up in their mountain home, a mere isolated basin, where competition must have been very excessive, nature took advantage of every favorable variation and developed those striking excellences peculiar to the Italian. During these ages there was no kindly bee-master possessed of the intelligence sufficient to nurse the weaklings, nor any "Dollar Queen business" to stimulate indiscriminate breeding, and the weak died victims to starvation. And so we are indebted to the stern, inexorable law of nature for the incomparable breeding which wrought out such admirable results in far-famed Liguria. Unquestionably the crowded apiaries of Austria and Germany have heightened the "struggle for life," and had a similar tendency to develop superior excellence in the European black bees. It is more than probable that the German bees of crowded Europe have longer tongues and are generally superior to the same in America, where they have long been favored with broad floral areas and comparative absence of competition. I should expect that this very law might have developed varieties of the black race which are superior to others of the same race. It is more than possible that "survival of the fittest" explains the origin of the superior varieties which are said to exist in various provinces of Europe. For the same reason we should surely expect superior excellence in the Cyprian bees. Crowded as they have been for long years or ages in their small island home, the principle of "survival of the fittest" must have been working powerfully to weed out the inferior and to preserve and make stronger the superior. And so the great poet has well said: "Sweet are the uses of adversity."

From the above considerations it seems obvious, that would we perpetuate the excellencies given us by the skillful breeding of nature, though we may not destroy all the feeble, as nature has done, we must assuredly study and observe so closely, that we shall know of a surety which are our very superior queens, and be even

more careful to breed from no other. Whether care or carelessness will be most promoted by our present system I leave for you to say. But I do wish that we might have at least a few breeders with time, means, caution, skill and patience, who would work with earnest zeal to not only keep all the excellence we now have, but to augment this excellence, as I am sure it may be augmented.

But if our cheap queen system is to continue, then, surely, we may well stimulate frequent importations from Italy and Cyprus, and thus hope to compensate in part for what will be lost by hasty, careless and indiscriminate breeding.—*American Bee Journal.*

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RECENT LITERATURE.

BREHM'S ANIMAL LIFE.[1]—This volume treats of the fishes, and is smaller than the others of the series. Beginning with the Dipnoans, the larger part of the space is devoted to the bony fishes, closing with the Selachians, the Cyclostomata and Amphioxus. The style is highly popular, as few anatomical details are given, but the text is taken up with very general accounts of the natural history of the more interesting species, with popularized illustrations in wood and full-page copper plates. In the preliminary glance at the life of fishes in general, their structure and physiology, habitats, distribution, habits and mode of development are, as well as fisheries and fish culture, briefly discussed. The Dipnoans are too briefly disposed of, only the Protopterus or lung-fish of Africa being figured and described; nothing is said of the Australian lung-fish (Ceratodus), nor of the relations of the Dipnoans to their mesozoic ancestors. The opportunity of working up a fresh and attractive account of the most interesting group of fishes in existence is not taken, and this part is nearly twenty years behind the times. The bony fishes are finely illustrated, the drawings of the eel, lump-fish and goose-fish, for example, being particularly good. We should have liked to have learned more of the singular breeding habits of the sea-horse; as to the garpike the reader is left in ignorance of its breeding habits so well known in this country, and the ganoids are too briefly treated; Ammocœtes is still regarded as an adult fish, though well known to be simply a young lamprey. On the whole, however, the volume is interesting and attractive, and so rich in good illustrations as to be of considerable value to the naturalist.

[1] *Brehm's Thierleben.* Achte Band. Die Fische. Von Dr. A. E. BREHM. 114 cuts and 11 plates. Leipzig, 1879. 8°, pp. 426. For sale by B. Westermann & Co., New York.

GRENACHER'S RESEARCHES ON THE EYES OF ARTHROPODS.[1]—This is the most elaborate and detailed work on the eyes of insects and crustacea which has yet appeared. For the first time we have very full information given us as to the nature of the simple eyes (ocelli or stemmata) of larval insects and of Arachnida, and we are here taught that they are much more complicated than was before suspected; so that they are not exactly a simple, elementary eye, as it were, a primitive form of eye, but, as the author claims, the simple and compound eyes stand in the relation of sisters, rather than of child and parent.

A long chapter on the physiology of the compound eyes lends additional value to the anatomical portion. The author concludes that perception in the compound eye of Arthropods is effected in accordance with the theory first proposed by Müller, and that this applies to the compound eye of the horse-shoe crab (Limulus) although morphologically the eye of this animal is totally unlike that of any insect or crustacean. Grenacher does not describe the eyes of the myriopods, though he observes that the compound eyes of Cermatia are entirely unlike those of the spiders or insects, and that they seem to show some analogy to those of Limulus. The illustrations are abundant and simply exquisite, and worthy of the text.

DALL'S METEOROLOGY OF THE PACIFIC COAST PILOT.[2]—This is the results of several years' examination by Mr. Dall into the meteorological features of Alaska, together with the data collected from the publications of learned societies and from unpublished material in the archives of the U. S. Coast Survey, the Medical Department of the U. S. Army, and the U. S. Signal Service, as well as numerous contributions from private sources. The whole appears to be a most useful and accurate account of the climatic features of Alaska. While the attempt has been made to elucidate the general climate of this region, the local peculiarities relating especially to commerce, navigation and agriculture have been made sufficiently prominent. To geographers and Arctic explorers this volume will especially commend itself, as well as to students of the geographical distribution of plants and animals. To the latter the charts will prove useful; that showing the distribution of plants and animals, and the following one (XXVIII) showing, with the summer sea-surface temperature, the limits of trees, are new and fresh contributions to our knowledge of the life of this and the neighboring subarctic regions.

[1] *Untersuchungen über das Sehorgan der Arthropoden, insbesondere der Spinnen, Insecten und Crustaceen.* Von H. GRENACHER. 11 lith. plates. Göttingen, 1879. 4°, pp. 188. 45 marks.

[2] *U. S. Coast and Geodetic Survey.* C. P. PATTERSON, Superintendent Pacific Coast Pilot, Coasts and Islands of Alaska. Second Series. *Meteorology.* By W. H. DALL, Acting Assistant U. S. Coast Survey. Washington, 1879. 4°, pp. 375. 28 charts and 12 plates.

This volume will admirably supplement the series of memoirs in course of publication on the marine zoölogy of Alaska by Mr. Dall, who has made very extensive collections on the coast of Alaska.

BARRANDE'S BRACHIOPODS OF BOHEMIA.[1]—This volume of extracts from the fifth of the magnificent series of the *Systême Silurien du Centre de la Bohême*, is of very general interest to palæontological students, since it gives the results of the author's studies upon an interesting series of faunæ, where the succession is quite complete; and although the distinguished author is quite fully persuaded that his facts and inductions are opposed to the theory of descent, others who favor the theory find these profound works rich in facts and inferences which go to strengthen their own views; so anything that comes from the palæontological workshop at Prague—and least of all are they mere chips—is always welcomed.

It will be seen how useful to the general student of biology this book will prove when we enumerate the subjects here treated:

I. Variations observed among the Silurian Brachiopods of Bohemia.

II. Vertical distribution of the genera and species of Brachiopods in the Silurian basin of Bohemia.

III. Specific connections established by the Brachiopods between the Silurian faunæ of Bohemia and the Palæozoic faunæ of foreign countries.

HUXLEY ON THE CRAYFISH.[2]—Whether it is because we happen to be just now greatly interested in the crayfish and its belongings, or because this book is in itself very attractive, we confess ourselves very much pleased and interested in it. The method of teaching zoölogy now-a-days is to induce the student to learn all he can from the thorough, detailed study of one or several types, rather than to bewilder his brain with a ponderous classification of the entire animal kingdom and a large but thin mass of superficial pseudo-knowledge of it. He is now taught to become, *ab initio*, an original investigator, to discover new facts for himself, or at least to discover what are to him new facts, and thus enthusiasm and real interest in the subject are bred. Just now a class of college students are studying with us and drawing the structure of the lobster, and with most excellent results in the way of exciting their interest and curiosity; judging by the results this seems to us to be the very best way of teaching natural history. This book, which is a monograph of the crayfish from

[1] *Brachiopodes.* Etudes locales. Extraits du Systême Silurien du Centre de la Bohême. Vol. v. Brachiopodes. 7 Planches. Par JOACHIM BARRANDE. Prague et Paris, 1879. 8°, pp. 356.

[2] The International Scientific Series. The Crayfish. An Introduction to the study of Zoölogy. By T. H. HUXLEY. With 82 illustrations. New York, D. Appleton & Co., 1880. 12°, pp. 371.

every point of view, will prove a great aid in such teaching. The story is told in a straightforward, honest way, and so truthfully that there is little or no room for fault-finding. We may not believe, with the author, that the eyes of the crayfish or any other Crustacean are homologous with the legs, but this does not impair our enjoyment of the story of the structure of the eye and how the crayfish sees, and how its mind, or what answers to a mind, operates. The illustrations are most excellent.

THOMAS' NOXIOUS INSECTS OF ILLINOIS.[1]—Instead of trying to cover the whole or even the larger part of the field, the author has wisely confined himself to working up one and a very important group of injurious insects, the plant lice. The group is treated of systematically, the genera and species described at sufficient length for determination, and their habits described as fully as possible, with remarks on their insect enemies and the best remedies against their attacks. With this report in hand any one in Illinois or adjoining States, whose crops or fruit trees or flowers are afflicted by these troublesome pests, can ascertain their affinities and names, and the best means of getting rid of them. A great deal of useful information is scattered through the report, which, barring some defects in its typographical appearance, the common fault of State reports, is well worthy of wide distribution and use by farmers and gardeners. A number of new species are described, and as this volume is the first attempt to treat monographically of this extensive family of insects, it is worthy of the attention of the entomologist as well as the layman.

RILEY ON THE COTTON WORM.[2]—This third Bulletin of the U. S. Entomological Commission gives the results of Prof. Riley's researches on the cotton worm (*Aletia argillacea*), which is so injurious to the cotton plant that the average annual loss is estimated at over $12,000,000. The author, after treating of the losses sustained from the attacks of this caterpillar, describes the egg and metamorphoses and habits of the insect in its different stages. Riley has discovered that, contrary to the usual impression, the worm hatches in April, and that the third generation is the most abundant, this having usually been regarded as the first, there being seven annual generations in the extreme Southern States. The relations of the soil, of the weather, to the development of the caterpillars are referred to; and the author states his belief that the moth hybernates in the southern portion of the

[1] *Eighth Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois.* Third Annual Report by CYRUS THOMAS, State Entomologist. Springfield, 1879. 8°, pp. 212.

[2] Department of the Interior. United States Entomological Commission, Bulletin No. 3. The Cotton Worm. Summary of its Natural History, with an account of its Enemies, and the best means of controlling it; being a report of progress of the work of the Commission. By CHARLES V. RILEY, M.A., Ph. D. Washington, January 28, 1880. 8°, pp. 144, with numerous illustrations.

cotton belt, though most of the moths die off in the autumn. The insect parasites, twelve in number, which prey upon them are described, while a large part of the Bulletin is taken up with the various remedies employed, of which Paris green, London purple, these being preparations of arsenic. are strongly advocated, and a number of machines and contrivances for sprinkling and spraying dry and liquid poisons are figured and described. The work will be of great use to cotton planters; and to entomologists the entire subject and its skillful mode of treatment will render it of permanent value.

GILBERT'S GEOLOGY OF THE HENRY MOUNTAINS.[1]—The teacher as well as student of general geology in this country who would be at all informed as to the broader features of American geology and palæontology is compelled to resort to the magnificent series of reports of our geological surveys of the Western Territories. These, almost without exception, have been ably prepared, and in most respects certainly worthy of the time and money bestowed upon the work. From them have been and will be largely derived the materials for our text books. The present monograph, though not bulky, is a finished and elaborate study of an interesting group of mountains forming one of the western outlines of one of the flexures of the Rocky Mountain range, and rising suddenly from what has otherwise been a region of geological calm. This group of five elevations forms as many *laccolites*, as the author terms them. It is usual, he says, for igneous rocks to ascend to the surface of the earth and build up mountains or hills by successive eruptions. Such are volcanoes. Now, when the lava, instead of rising through all the beds of the earth's crust, stops at a lower horizon, and insinuates itself between two strata and opens for itself a chamber by lifting all the overlying strata, and here cools, forming a massive body of trap, a laccolite (*laccos*, cistern, and *lithos*, stone) is formed. This is the mode in which the Henry Mountains were formed, as well as numerous other isolated groups in the Plateau region. That many similar peaks, with the Elk mountains of Colorado, elaborately described by Messrs. Holmes and Peale, of Hayden's Survey of the Territories, were formed in an identical manner has been independently established by these geologists, as stated by our author.

Gilbert also makes the generalization that there are two types of igneous rock. "One type of rock is acidic, including porphyritic trachyte and eruptive granite, and its occurrence is, without exception, intrusive. The other type of rock is basic, including basic trachyte and basalt, and its occurrence is almost uniformly extrusive." It appears that each group of laccolites is composed

[1] Department of the Interior. U. S. Geographical and Geological Survey of the Rocky Mountain Region. Report on the Geology of the Henry Mountains. By G. K. GILBERT. Washington, 1877. (Received Nov. 10, 1879.) 4°, pp. 160. 5 plates and wood-cuts.

of many individuals, just as volcanoes are dotted over with miniature volcanets, so to speak, as may be seen on the flanks of Mt. Shasta. For example, "in the Uinkaret mountains, Major Powell has distinguished no less than one hundred and eighteen eruptive cones, and in the Henry mountains I have enumerated thirty-six individual laccolites. In one locality basic lava has one hundred and eighteen times risen to the surface by channels more or less distinct, instead of opening chambers for itself below. In the other locality porphyritic trachyte has thirty-six times built laccolites instead of rising to the surface." In answer to the question, why in some cases igneous rocks form volcanoes and in others laccolites, it is stated that "when lavas forced upward from lower lying reservoirs reach the zone in which there is the least hydrostatic resistance to their accumulation, they cease to rise. If this zone is at the top of the earth's crust they build volcanoes; if it is beneath, they build laccolites. Light lavas are more apt to produce volcanoes; heavy, laccolites. The porphyritic trachytes of the Plateau Province produced laccolites." The process of formation is thus summarized: "The station of the laccolite being decided, the first step in its formation is the intrusion along a parting of strata, of a thin sheet of lava, which spreads until it has an area adequate, on the principle of the hydrostatic press, to the deformation of the covering strata. The spreading sheet always extends itself in the direction of least resistance, and if the resistances are equal on all sides, takes a circular form. So soon as the lava can uparch the strata it does so, and the sheet becomes a laccolite." It then grows in size until the lava clogs by congelation in its conduit and the inflow stops, the irruption being completed. During the eruption and after it has ended there is an interchange of temperatures. The original laccolite thus growing by successive additions until its cooled mass, heavier and tougher than the surrounding rocks, proves a sufficient obstacle to intrusion. "The next eruption then avoids it, opens a new conduit, and builds a new laccolite at its side. By successive shiftings of the conduit a group of laccolites is formed, just as by the shifting of vents eruptive cones are grouped." Now the strata above are bent instead of broken, but though "quasi-plastic, it is none the less solid, and can be cracked open if the gap is instantaneously filled, the cracking and filling being one event. This happens in the immediate walls of the laccolite, and they are injected by dikes and sheets of the lava."

We must here remark that the impression left on the mind after having read this book, is that the discovery of this type of mountain structure is entirely due to Mr. Gilbert, although a careful reading shows that he recognized the fact that the Henry mountains are not the only examples of what he terms the "laccolite." Prof. Newberry, who examined the Sierra Abajo in 1859, was probably the first to recognize the peculiar structure,

but his examinations were rather cursory. This mountain, with others farther to the east, were carefully studied by Mr. W. H. Holmes, of the Hayden Survey, in 1875 and 1876, and his illustrations in the reports for those years show the same structure in the La Plata mountains, the Sierra Carrisso, and the Sierra El Late, in South-western Colorado and adjacent regions, with some points that do not appear in the Henry mountains, probably on account of the greater simplicity of the latter. Mr. Holmes' drawings appear to be nearer to nature, *i. e.*, less schematic. Scattered through Hayden's reports from 1873 to 1876 are many descriptions of this type of structure, and the term *Porphyritic-Trachyte* (p. 64 and 68) used by Mr. Gilbert to designate the group to which the rocks belong, was first used by Dr. A. C. Peale, of Hayden's corps, in 1874 (see his report for 1874 in Hayden's Annual Report), and afterwards he always used the term in designating the rocks.

Mr. Clarence King, in his report (Systematic Geology, 1878, p. 581), proposes the name *Trachytoid-porphyry* for the group, having recognized the resemblance of certain rocks occurring within the area of his explorations, to those of the Henry mountains. He also recognizes the peculiar petrographical position of the rocks, one extreme of which cannot be distinguished from granite, and the other of which is undoubtedly trachyte. This fact was also pointed out by Dr. Peale in 1874 and 1875 (see his reports to Dr. Hayden). The descriptions of the localities mentioned in Dr. Hayden's Annual Reports were brought together in an article (On a peculiar type of Eruptive Mountains in Colorado) in Bulletin No. 3, Vol. III, of the U. S. Geological Survey of the Territories, published May 15, 1877. Mr. Gilbert's volume is dated Washington, 1877, although it was not published until about four months ago.

BATRACHOLOGICAL PAPERS.—Prof. Peters, of Berlin, has recently published an important paper in the Berlin Monatsberichte,[1] on the *Cæciliidæ*. He discovered two new generic forms in which the usual position of the orbit is covered over by the squamosal bone, thus enclosing the rudimental eye in the fundus of the tentacular canal. One of these, *Gymnopis*, is American; the other, *Herpele*, is African. Prof. Peters then discusses the systematic arrangement of the family, and shows that it embraces ten generic forms, seven of which are new. Among other characters he relies on the form of the tentacle, which may be valve-shaped, globular at the extremity, or acute. He finds that the generic name *Rhinatrema* was proposed on an immature *Ichthyophis*.——In another paper Prof. Peters[2] describes two new species of *Œdipus*, one

[1] Ueber die Eintheilung der Cæcilien, und insbesondere ueber die Gattungen *Gymnopis* u. *Rhinatrema*. Nov., 1879.

[2] Monatsberichte Berliner Akademie, August, 1879.

from New Grenada, the other from Hayti. If the latter locality is correct, it gives an entirely new distribution for the genus.——It is now some time since M. Fernand Lataste of Paris, showed that the larvæ of the *Batrachia Anura* with opisthocœlous vertebræ have their branchial fissure median, while those with procœlous vertebræ have it on the left side. In a more recent paper[1] this author discusses the position of the genus *Discoglossus* in the system, and gives much new information respecting the habits, varieties and larvæ of the *D. pictus.* He adopts the system proposed by Cope in 1864, in which *Discoglossus* is placed with *Bombinator* and *Alytes* in a special section of the *Anura*, apart from the ranoid and pelobatoid types. M. Lataste creates a number of new names. The distinction in the articular character of the vertebræ had not been used by Cope as the basis of a primary division on account of its uncertainty in some *Cystignathidæ*, but M. Lataste adopts an opposite course. He also gives tribal names to the group with and without ribs, which, in our opinion, increases nomenclature unnecessarily. For this reason we commend his rejection of the new names proposed by M. DeLisle.

Osteological Contributions.—Prof. Allen, of Philadelphia, has recently made some interesting observations on the ethmoid and turbinate bones of the Chiroptera, which are noticed in the Bulletin of the Museum of Comparative Zoölogy, Cambridge.[2] Among other things he finds that in the *Pteropidæ*, *Nycteridæ* and some *Phyllostomidæ*, a horizontal plate extends "from the under free edge of the vertical plate" of the ethmoid "to the nasal septum. The olfactory surface in such forms is thus withdrawn from the respiratory currents, since no direct outlet exists at the posterior nares."——Prof. E. D. Cope has recently published in the Proceedings of the American Philosophical Society,[3] a description of the foramina which perforate the temporal and adjacent parts of the parietal bones of the *Mammalia.* He finds nine of these which are generally constant in position, but present great variety in their occurrence in the different orders, families and genera. Three of them are confined to the *Menotremata* and *Marsupialia*, while there are many of the higher types which do not possess any of them. The largest number is present in the equine *Perissodactyla* and the *Ruminantia.* Prof. Cope's conclusions are stated as follows:

(1.) The sinous foramina furnish valuable diagnostic characters, and may, with proper limitations, be used in systematic definition.

(2.) The primitive condition of the various Mammalian orders, appears to have been the possession of a limited number of these formina.

[1] Actes de la Société Linneenne de Bordeaux, XXXIII, p. 275, 1879.
[2] Vol VI, No. 5, Feb., 1880.
[3] No. 105, March, 1880.

(3.) The Monotreme-Marsupial line have developed a number of foramina in their own special way.

(4.) The *Rodentia* have chiefly developed those of the inferior part of the squamosal bone, if any.

(5.) The *Carnivora* commenced with but few foramina, and have obliterated these on attaining their highest development.

(6.) The history of the *Quadrumana* is identical with that of the *Carnivora.*

(7.) The *Perissodactyla* present very few foramina in the lowest forms, and did not increase them in the line of the *Rhinocerida.* In the line of the horses an increase in their number appeared early in geologic time, and is fully maintained in the existing species.

(8.) In the Omnivorous division of the *Artiodactyla* time has obliterated all the sinous foramina. In the camels an increased number was apparent at the same geologic period as in the history of the horses (White River or Lowest Miocene), and has been maintained ever since; while the existing *Pecora* present a larger number of the foramina than any of the class of the *Mammalia.*

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GENERAL NOTES.

BOTANY.

THE HUMBLE BEE A DYSTELEOLOGIST AMONG ALPINE FLOWER VISITORS.[1]—In the interesting article of which this is an abstract, Dr. Hermann Müller considers the distelеological actions of the alpine humble bee *(Bombus mastrucatus).*

As Haeckel has shown, structures which are useless or harmful to the possessor are at once the most insurmountable obstacles to teleology and the finest foundation for disteleology. Very important among these are rudimentary organs; but this field is much more comprehensive than Haeckel made it, or, indeed, could have made from his morphological standpoint, for rudimentary organs are always at first the morphological results of biological causes, and may always be traced to some change of habits in living beings. Their uselessness begins not with the commencement of atrophy, but with the change of habits which is the cause of this atrophy.

The different living beings of any given place are so variedly and closely connected by their mutual relations that a change in the habits of one species is indicated not only by the consequent uselessness of its own organs but also by the accompanying uselessness of those of other species which were closely adapted to it under former conditions. The numerous, well-determined mutual relations existing between flowers and insects serve especially well

[1] "Bombus mastrucatus, ein Dysteleolog unter den alpinen Blumenbesuchern." Dr. Hermann Müller, Kosmos, Band III, Heft 6, p. 422.

in the study of disteleology. The closeness of these relations Dr. Müller has shown in previous articles.[1] Any change in the one must react on the other and produce some effect. For example, no teleologist could desire a more perfect adaptation of two forms one to another than is afforded by the sucking mechanism of the humble-bee and the complicated lever-work for securing pollination in the meadow-sage. But if it chance—and this is really the case in some places—that there are found with the ordinary form of this sage small-flowered varieties which are visited, on an average, later than the large-flowered form, and therefore are fertilized by pollen taken from the latter, the beautiful lever-mechanism of the anthers in the small flowers becomes useless at once, and passes from the province of teleology into that of disteleology; it becomes a rudimentary organ, and as such is actually found in all degrees of atrophy. Or, again, if a species of humble bee belonging to the most frequent visitors of these flowers should find it too much trouble to set the anther-levers in motion, and should take to perforating the floral envelopes from the outside and through these stealing the nectar, it would not only cease to employ its tongue in a way fully corresponding to the degree of its development, but it would render the anther-mechanism of the flowers entirely useless in all of its visits. Indeed, were the not improbable case to occur, in which other species of bees, finding the nectar constantly gone from these flowers, should entirely lose their habit of visiting them, the flowers would never be fertilized, and the meadow-sage would die out in the regions where this occurred. The change in habits of the piratical bee would thus have as a result the changing of the habits of all other humble bees; and from the moment when this occurred the wonderful contrivances by which no insects but these bees can fertilize the flowers would become not only useless but absolutely destructive, and this, without the formation of rudimentary organs. Such a bee, obtaining nectar by robbing from flowers adapted to its visits for their fertilization sets at nought the theory of teleology, and merits in a high degree the name of a disteleologist.

Of this character is the *Bombus mastrucatus* of the Alps; which, moreover, does not content itself with breaking into and stealing nectar from flowers which it cannot enter in the normal way, but has become so addicted to the exercise of violence that it only enters a flower regularly when this is less trouble than perforating its corolla.

The good deeds of this insect, and those by which it is connected with the theory of teleology are few in number, and confined almost exclusively to such flowers as those of the Compositæ, which are not especially adapted to bees, but are open to the visits of all insects. But while it visits these in the normal way—

[1] See the NATURALIST for April, 1879, p. 257.

because it would be more trouble to get at their nectar in any other—its more ravenous appetite and greater dependence upon plant-food are the only causes which render its visits more frequent than those of less-specialized insects, and its value to the plant greater; for visit for visit, they are as effective in fertilizing the flowers as it is. Such flowers as those of *Thymus serpyllum*, which are only slightly modified, are not as a rule perforated; nor are pendant flowers like those of *Campanula rapunculoides*. But of bee-flowers like those of *Aconitum napellus* very few are visited regularly before a systematic perforation of their corollas is begun. In a few other cases where this bee either leaves the nectar untouched or obtains it by force it collects pollen, and in so doing aids in the fertilization of the flowers.

Were we only to count the flowers which this bee visits in the normal way, and those which it perforates, we might infer that its good and evil deeds stand pretty evenly balanced; nevertheless it would always remain a disteleologist because it seldom uses its own organs in a way corresponding to the completeness of their development, and, moreover, breaks ruthlessly through the most highly developed floral structures, so that to a certain extent both its own organs and those of the flower are rendered useless. But to fully appreciate its injuriousness we must note how greatly it prefers those richly nectariferous flowers which it perforates to those with less nectar which it visits normally. So great is this preference that it is astonishing to see how few flowers of such species as *Salvia pratensis* remain unperforated.

Bad in itself, this habit of perforating flowers is rendered still worse for the plants by the habit which certain other insects have of obtaining nectar through openings already formed, though they would not form any for themselves. This limits still more the number of useful visitors of the flowers. Hence it is not improbable that this bee may have been the cause of the extinction of many alpine plants; and one can scarcely doubt that changes in flowers which tend to check or stop perforation by it have been taken up and developed by natural selection from the time when this unnatural action first began. An instance of partial protection against this bee is afforded by *Rhinanthus alectorolophus*, where the inflated calyx and the firm, smooth arch of the corolla together protects the flowers from forcible removal of their nectar, and force the bee to aid in their fertilization or go without the sweets. In *Pedicularis verticellata* the perforation of the floral envelopes is partially prevented by the globular form of the calyx, the abrupt, rectangular bend of the corolla within, and its smooth, laterally compressed condition without the calyx.

It is easily seen why rudimentary organs are not formed in flowers robbed of their nectar by our bee; for bee- and butterfly-flowers which are thus treated either receive enough visits from other species to ensure their fertilization and prevent the abortion

of their organs, or their other visitors are crowded out to such an extent that the plant perishes at once, giving no opportunity for the formation of any rudiments. Nor can the sucking apparatus of the bee become rudimentary, for it is employed constantly in obtaining nectar even from those flowers which are broken into. Only in case the robber-bee formed the habit of biting off all nectar-containing parts, or of stealing honey already collected by other bees, could its tongue become abortive. What would occur in the the latter case is seen in the Brazilian *Trigona limæ*, which has this habit. The disused tongue is here very small, while the mandibles, being more frequently used, are unusually large and strong.—*W. Trelease.*

BOTANICAL NOTES.[1]—The *Botanical Gazette*, for December, furnishes articles by C. C. Pringle, on dimorpho-dichogamy in *Juglans cinerea*, and on the leaf propagation of *Nasturtium lacustre*. To the January number Dr. Gray sends notes on Tennessee plants and records the occurrence of Littorella and Schizæa in Nova Scotia. Dr. George Engelman writes on *Catalpa speciosa*. In the February number are notes on *Viola tricolor* by Prof. T. C. Porter.——To the *Bulletin* of the Torry Botanical Club, for December, 1879, Mr. Pringle contributes notes on Northern New England plants, and *Aspidium spinulosum* is noticed critically by Mr. B. D. Gilbert. The death of Dr. F. J. Bumstead, a student of vegetable anatomy and physiology, which occurred November 28th, is also announced.——The *California Horticulturist* always contains a good deal of botanical matter of general interest; to the January number S. B. Parish contributes a notice of the Pentstemons of Southern California.——In Trimen's *Journal of Botany*, for January, is a plate representing a curious pitcher plant (*Nepenthes dyak*), and an article by G. Nicholson on *Spergula arvensis*. Reference is made to an article by P. Sagot on the influence of the hygroscopic state of the air on vegetation. The death of Dr. H. Bauke, December 15, is announced. He was well known by his work on Pycnidia, fern prothallia, &c.——The January number of the *Quarterly Journal of Microscopical Science* contains several botanical articles of special value. H. M. Ward discusses the embryo-sac and development of *Gymnadenia conopæa;* the pollen-bodies of Angiosperms are treated of by F. Elfving; the development of the conceptacle in the Fucaceæ, by F. O. Bower. In his article on the Bacillus of leprosy, G. A. Hansen describes and figures Bacilli found in leprosy tubercles and pus, but does not go so far as Neisser and Edlund in attributing this loathsome disease to these microphytes.——Contrary to Darwin's conclusions that Drosera is carnivorous, Prof. Regel finds, on comparing a number of plants fed with meat with a series which were not, that while the average weight of the seeds was greater in the former case, this was more than compensated by their much smaller

[1] A portion of these notes were crowded out of the March number.—EDITORS.

number, the gross weight being considerably less. He found also that the leaves were obviously injured by the flesh food and that the power of the plants to resist the winter was diminished. He thinks the epithet "carnivorous" to be inappropriate. On the other hand, Von Heldrich, according to the *Journal* of the Royal Microscopical Society, has found a Pinguicula on the upper side of whose leaves are a large number of bodies of insects in an earlier or later stage of digestion by the glands plentifully sprinkled over its surface. This is the first insectivorous plant yet recognized in Greece.——By the will of the late Stephen C. Olney, of Providence, R. I., his herbarium of from 8000 to 10,000 species of plants, and his library of botanical works numbering some four hundred volumes, and an excellent microscope, with $10,000 for the increase of the library and herbarium, have been bequeathed to Brown University. The library contains many costly works. The herbarium comprises, besides a fine series of Carices, on which the donor bestowed much labor, many Western and South-western plants named by Gray, Cuban plants, Austin's, Sullivant and Lesquereux's mosses, and good series of algæ and lichens. The author's botanical labors were recognized some years since in the establishment of the genus Olneya. The College also receives from him the sum of $25,000 for a professorship of natural history.

ZOÖLOGY.[1]

TWENTY-SIX DAYS AT SEA, IN AN OPEN BOAT, CRUISING FOR WHALES.—We left San Francisco on a small steam propeller known as the *Rocket;* length about thirty-five feet, eight feet beam, and about five and a-half tons register.

The day we left being fine, we had a very pleasant trip as far as Point Reyes, which is about thirty-five miles north of San Francisco, but saw nothing of importance on the way, except now and then numerous albicore and the porpoises sporting in the sea. We anchored in Drake's bay for the night. Early on the following morning we steamed up and took a cruise outside, and in a few hours heard the familiar sound, "There she 'blows,'" and the captain, with spy-glass in hand, answering, "Where-away?" with the answer, "Just on the lee bow, about half a mile ahead!" Getting everything in order, we steered for him, and soon saw several whales swimming very fast and going northwards. Now one approaches which proves to be a sulphur bottom whale (*Sibbaldius sulphureus* Cope), seventy-five to eighty feet long, just under the bow of the boat, in fact almost too close for a shot. The captain fired one of the well-known Fletcher, Suits & Co. California whaling rockets, and patent bomb lance. This apparatus consists of a gun-metal cylinder filled with a peculiar composition made only by themselves, to which is attached, in front, a bomb

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

with a barbed point; inside the bomb (Fig. 1) is an explosive

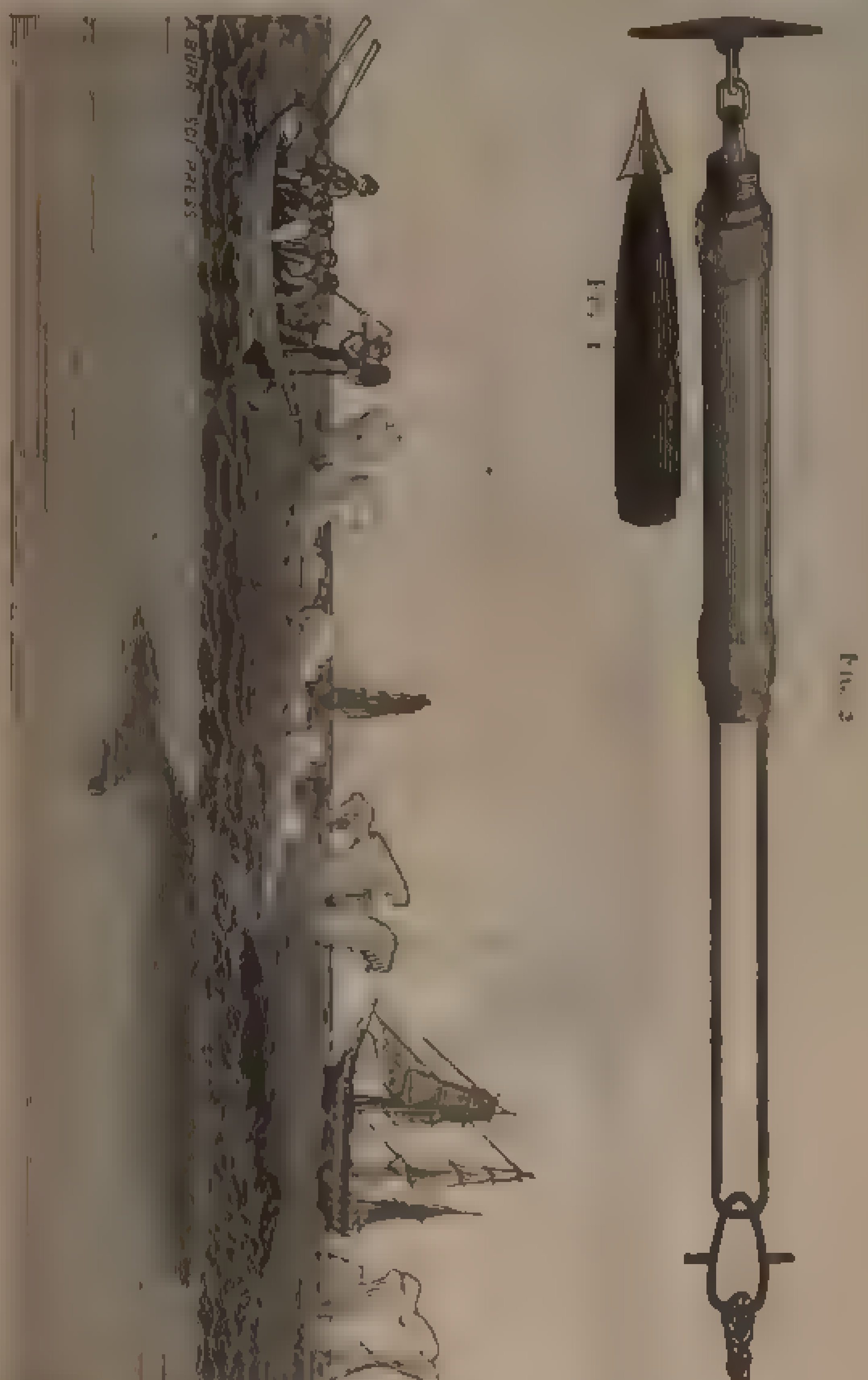

Fig. 1

Fig. 2

Fig. 3

CALIFORNIA WHALING ROCKET AND PATENT BOMB LANCE.

charge and a chain toggle, which is released by the bursting of the shell on entering the whale; an iron shaft is attached to the rear end of the rocket (as shown in Fig. 2) through which the whale line is spliced, this also shows the chain toggle after it is released, so that when it is inside of a whale it has a sure hold. In some experiments with these bombs on the beach before starting, one carried a whale line, of two and a-half inches in circum-

ference, about sixty fathoms, which shows what power they have, since a bomb and twenty fathoms of line weigh about fifty-five pounds.

These are generally fired from the bow of the boat. Fig. 3 gives a good idea of a man firing at a whale. Fig. 4 gives an enlarged view of the complete apparatus before being fired. The hinged flange is thrown up by the rocket passing out, protecting the face from injury. At a distance of from twenty to thirty fathoms it is almost sure to explode and kill the whale, if it hits him, but in our case, we being too close to the whale, about ten feet distant, the bomb went through him, just abaft of the flukes, and bursted on the outside, leaving the toggle on the outside of him; we were now fast, and the whale towed the propeller, which would, perhaps, weigh ten tons, coal and all, for three or four hours, with from twenty to forty fathoms of whale line, sometimes at the rate of ten miles an hour, although we were frequently backing under a full head of steam. This, if we were going ahead and nothing to hinder, would carry the propeller about ten miles an hour, thus showing the immense strength of the whale.

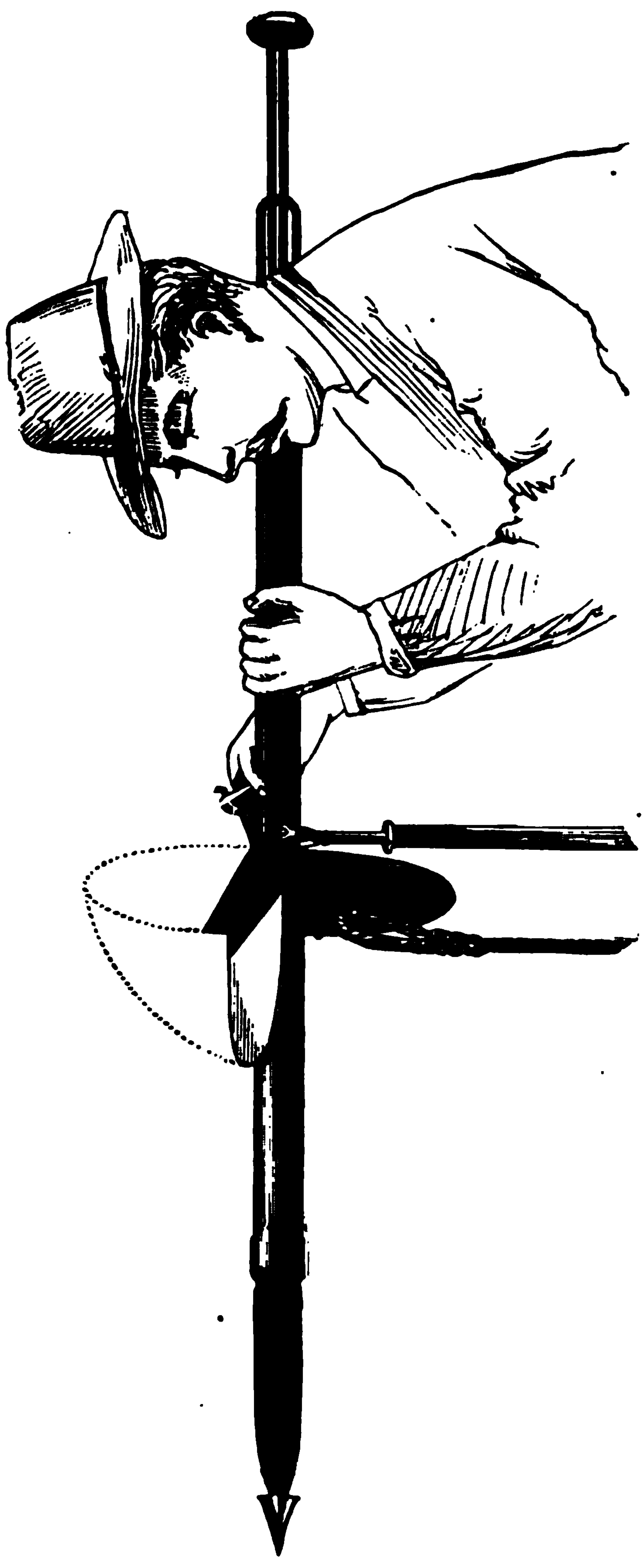

FIG. 4.—Enlarged view of the complete apparatus.

This species of whale is seldom attacked by the whalers on

account of its being so much swifter than any other whales known. We held on to him as long as we could, hoping he would soon give up, as he was going so fast and at such a distance from us, we could not get another shot at him, and it being near sundown, and we over ten miles from land, we commenced to shorten up the line as much as possible intending soon, if he did not give up, to cut the line and let him go. While doing so the line parted, and we lost about ten fathoms and the rocket. Thus ended one of the fastest and most exciting rides I ever had behind one of the monsters of the deep.

We now steamed towards Drake's bay, where we anchored for the night.

On a subsequent day we went out and saw numerous sulphur bottoms, but all swimming fast and going northward. We could scarcely approach them, but finally firing a shot at one, we missed him. We did not get any more chances at them during the day, and at night returned to Drake's bay.—*C. D. Voy.*

LIST OF CALIFORNIAN REPTILES AND BATRACHIA COLLECTED BY MR. DUNN AND MR. W. J. FISHER IN 1876.—The following species were collected by Mr. Dunn in a district about seventy-five miles south-east of San Diego:

BATRACHIA.

Plethodon croceater Cope.

OPHIDIA.

Crotalus lucifer B. and G.

LACERTILIA.

Cnemidophorus tessellatus sub. sp. *tessellatus* Say.
Callisaurus dracontoides Blainville.
Uta thalassina Cope.
Uta stansburiana B. and G.
Uta ornata B. and G.
Sceloporus clarkii subsp. *zosteromus* Cope.
Phrynosoma coronatum Blainville.

The following were collected in Lower California, at or to the south of Magdalena bay, by Mr. W. J. Fisher:

BATRACHIA.

Batrachoseps attenuatus ? La Paz.

OPHIDIA.

Hypsiglena ochrorhyncha Cope.
Rhinochilus lecontei B. and G.

LACERTILIA.

Chirotes sp. ? La Paz.
Cnemidophorus maximus Cope.
Phrynosoma regale Gir. Las Animas bay.
Dipsosaurus dorsalis Hallowell.

Prof. E. D. Cope has kindly identified the rarer species, and has verified the identification of the others.

The single example of *Plethodon croceater* is, I am told by P Cope, the only one now known to be extant.

Uta thalassina, a very rare species, is represented by two specimens.

The occurrence of Chirotes in Lower California has been previously noted by Prof. Peters, of Berlin, but as his papers upon the subject are not accessible to me, I cannot be certain to which of the two described species the specimens belong.

The *Batrachoseps* appears to be *attenuatus*, and if so, proves that species to have a more southerly range than has been hitherto supposed.—*W. N. Lockington.*

The Gastrula of Vertebrates and the Gastræa Theory.—The amount of attention now being given to embryology is very great, and of papers and memoirs upon this topic there is no end, while the subject is still apparently in its infancy. To Haeckel, who first showed that all animals above the Protozoans pass through a so-called morula and gastrula condition, much of this recent activity is due. However crude and open to criticism much of his work may have been, he has marked out a new line of investigation, and his gastræa hypothesis has been, with all its necessary assumptions and crudities, most fruitful in results. His early generalization that most if not all many-celled animals pass through the condition of a two-layer sac with a primitive opening and digestive canal (his gastrula) has been sustained by Balfour, Lankester, Kuppfer, Benecke, and others. The observations of the two last named authors on the salamanders, lizards and turtles have enabled them to extend the gastræa theory into the great division of the Amniote Vertebrata, and, it is claimed, does much to explain the phylogenetic history of the allantois. A gastrula state is now known to be common to Amphioxus, the lamprey, sharks, ganoids, bony fishes, as well as to all higher vertebrates. Kuppfer and Benecke have discovered that in the embryo turtle the gastrula-cavity is continued into the intestine (or hind gut) and that therefore it forms the rudiment of the allantois.

Zoölogical Notes.—A. D. Michael states in the *Journal* of the Royal Microscopical Society that after placing some Oribatid mites in one per cent. solution of osmic acid for several hours, and then putting them in fifty per cent. alcohol for several more hours, and finally in absolute alcohol for several additional hours, they came out, naturally to his surprise, "all alive and apparently not much the worse."——M. Dareste states that the amnion is occasionally absent in the embryo chick, though the germs would probably not live to break the shell.——In a paper on the locomotion of land snails, Dr. Simroth discusses the action of the muscles of the foot and their relation to the nerves, and draws attention to the interesting relations between the circulatory system and the locomotor muscles. It seems that the foot of the slug can only contract so long as it is swollen out by blood, the sinus in the middle line of the foot forming a veritable *corpus*

cavernosum.——Three species of Helix having been shown to be viviparous, a fourth (*Helix studeriana*, from the Leychelles) has been found by Vignier to bring forth its young alive.——The so-called proboscis of Pterotrachea, a Heteropod mollusc, has been found to possess organs of taste, the gustatory papillæ having, it is claimed by Todaro and Milone, the same structure as those of the Mammalia.——Indications of the molting of the horny beak of a penguin (Eudyptes) were presented to the Zoölogical Society by Dr. Mulvany.——It appears that the Phylloxera in France resisted the severe cold and deep snow of the past winter, the temperature in December having been below 10° and 12° F. No remedies have yet proved successful in dealing with this dreadful pest.

ANTHROPOLOGY.[1]

AMERICAN ETHNOLOGY.—In the history of every science there are periods when the student may lay aside the apparatus of the investigator and bring together the results of varied researches into one general view. Such an opportunity offered itself, and was well utilized, when Mr. John D. Baldwin, profiting by the labors of Schoolcraft, Squier and Davis, Stephens, Catherwood, the earlier Government surveys, and the Smithsonian Institution, as well as the older authorities, published, in 1871, his "Ancient America."

A personal familiarity with the very arena on which the history of the Mound-builders was enacted, and the accumulation of new materials, induced Dr. J. W. Foster, in 1873 to publish his "Pre-historic Races in the United States."

Since the explorations, upon which this work is based, were made, the Smithsonian Institution has continued to publish additional facts every year; the Centennial Exhibition has added fresh enthusiasm to archæological research, the Government surveys have brought to light the old civilizations of the Colorado valley, Dr. Rau has published his "Archæological Collection of the U. S. National Museum," the Peabody Museum, the Davenport Academy, and many other State institutions have sent forth the results of their special investigations, and finally, Mr. Bancroft's "Native Races of the Pacific States," has brought together about all that is valuable in the pages of its predecessors. Taking advantage of these accumulations, Mr. John T. Short, of Columbus, Ohio, has just brought out, through Harper & Brothers, a new summary entitled, "The North Americans of Antiquity: their Origin, Migrations, and the type of civilization considered."

The work consists of eleven chapters, treating of the ancient inhabitants of the United States, antiquity of man on the Western continent, origin of the ancient Americans, especially the Mound-builders, the Pueblos and Cliff-dwellers, the Mayas, and

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

the Nahuas, old world analogies with ancient American civilization, chronology, language, and finally, the possible methods of peopling America from the old world.

Since the author laid aside his authorities to abide with the printer, several very important contributions have appeared which would have thrown light upon his discussions, and which he, no doubt, would have been the first to utilize; notable among these are, "Habel's Sculptures of Santa Lucia," "Rau's Palenque Tablet," "Anales del Museo Nacional de Mexico," the writings of Bandelier, Icazbalceta, Stephen Powers, A. S. Gatschet, Col. Mallery, and above all, the immense linguistic and ethnographic material now collecting at the Bureau of Ethnology in Washington, under the direction of Major J. W. Powell.

But investigation must cease somewhere, and the author has produced, from the material at hand, by far the best summary of ancient North America which has yet appeared. We have followed him with great trepidation from the beginning to the end of his perilous undertaking, along the dizzy heights, the narrow ledges, the yawning abysses and the tumultuous floods. He has, at times, been lost to our view, and again seemed falling into the devouring torrents. We could hear some of our brethren shouting, "Climb a little higher!" "Stoop a little lower!" "Lean to the right!" "Lean to the left!" "Come my way!" But on the whole, Prof. Short has made a successful trip, though, doubtless, feeling much as Maj. Powell's party did when they emerged from the cañons in 1869, or like Dr. Grove, who closes his Greek dictionary with the ejaculation, "Glory to God."

The opinions most strenuously advocated are: 1. That the Mound-builders were not red Indians; 2. That they were related to the Nahuas of Mexico; 3. That man is not autochthonous in America, that the claims of excessive antiquity are not valid, in fine, that he has not been upon the continent over 3000 years; 4. That the multitudinous theories of European and Asiatic migrations, of which a very complete list is given, while valuable as traditions, lack confirmation; 5. That the ancient Americans were not a single race, as held by Morton; 6. The very high degree of artistic and scientific knowledge possessed by the Mayas and Nahuas; 7. The value of Landa's Syllabaries in the future decipherment of Maya hieroglyphics; 9. The great merit of the Maya-Quiche literary remains. "The poetry of the Quiche cosmogony must some day find expression in verse of Miltonic grandeur. The fall of Xibalba will, no doubt, afford the materials for an heroic poem which will stand in the same re lation to America that the Iliad does to Greece. The doctrines of the benign and saintly Quetzalcoatl, or Cukulcan, must be classed among the great faiths of mankind, and their author, alone of all the great teachers of morals, except Christ himself, inculcating a positive morality, must be granted a precedence of most of the

great teachers of Chinese and Hindoo antiquity;" 10. "While the probability is preëminent that the ancient Americans are of old world origin, and that the Mayas and Nahuas reached this continent from opposite directions, it is certain that the civilization developed by each people is indigenous."

PERUVIAN ANTIQUITIES.—Those who have read with pleasure Squier's "Peru," published by the Harpers in 1877, will, no doubt, be delighted to see the following title and table of contents of the most thorough work on Peruvian antiquities that has yet appeared:

Wiener, Charles. Pérou et Bolivie. Récit de voyage suivi d'etudes archéologiques et ethnographiques et de notes sur l'ecriture et les langues des populations indiennes: Ouvrage contenant plus de 1100 gravures, 27 cartes et 18 plans. Paris, Librairie Hachette et Cie., 79 Boulevard Saint Germain, 1880. Droits de propriété et de traduction réservés. In 1875 M. Wiener was sent by the Minister of Public Instruction of France to Peru and Bolivia upon an archæological and ethnographical mission to last two years. The observations of the author are classed into four groups: 1. Account of his travels; 2. Archæological researches; 3. Observations upon ethnography; 4. Linguistic studies. In giving an account of antiquities, M. Wiener observes that he does not take upon himself the office of the panegyrist nor that of the detractor, but confines himself to an accurate account of the witness of these ancient civilizations, dividing them into three classes, architecture, sculpture and decoration (peinture).

GEOLOGY AND PALÆONTOLOGY.

NOTE ON THE ANDROSCOGGIN GLACIER.—Traces of a local glacier along the valley of the Androscoggin, from the White mountains to West Bethel, Maine, were first discovered by Prof. A. S. Packard, Jr., and Prof. G. L. Vose, and described by them in the first and second volumes of the AMERICAN NATURALIST. The flow of this glacier was subsequent to that of the great ice-sheet. More recently Prof. C. H. Hitchcock has described the glacial drift of this region in the New Hampshire Geological Reports. He also found abundant traces of such a glacier.

During June, 1879, while studying the modified drift of the Androscoggin valley, the writer incidentally noted the signs of the local glacier. The most unique morainal mass which I found in the valley has not, so far as I know, heretofore been described. It is on the south side of the river, just at the State line. The Androscoggin which has been for a mile or two running south-easterly, here abruptly bends to the north-east. Here also the State Line brook, a roaring stream eight or ten feet wide, comes in from the south. It drains a wide mountain basin which inclines down to the Androscoggin by a moderately steep slope. This slope shows a short terrace near the steam; otherwise it is

covered with ordinary glacial till, with the exception of a mass of loose morainal materials lying in the woods a short distance east of the brook. A number of white birches and poplars led me into the thicket under a suspicion of kames, and thus I stumbled upon this deposit. Its southern portion (it is separated into two parts by a depression) consists of a ridge from five to fifteen rods wide and rising from ten to thirty feet above the surrounding slopes of the hill. Here are some granite bowlders, closely resembling, if not identical with the outcrop of gneiss found a short distance west of here, near the river. The northern portion consists of a V-shaped mass with the apex south. It is composed of two ridges making the angle of 60° with each other, which are connected on the north by an irregularly curved ridge, the whole enclosing a shallow funnel or "potash kettle." Of these the western ridge is prolonged somewhat to the north of the cross ridge in the form of a row of conical hillocks which reach down nearly to the upper terrace of the river valley. This western ridge is nearly in line with the southern ridge first described (perhaps they are really one ridge), and both bear nearly due magnetic north, thus crossing the State line obliquely. From the eastern ridge a short spur juts to the south. The northern end of these ridges must rise fifty or more feet above the underlying hill. The ridges all slope outward in all directions, often as steeply as loose materials will lie.

By aneroid the height of the ridges above the river varies from 180 to 200 feet, and perhaps there were places a little higher than those measured. In places the materials show signs of water-wash, with a loose structure as of gravelly upper till. Along the south bank of the Androscoggin are many morainal masses left by the great glacier, but this is evidently a very different deposit. Considering the shape of the mass, its situation, its height, its materials and the steepness of its slopes, I regard it as a moraine of the local glacier. It is one-third of a mile long and at one point is about one-eighth of a mile wide.

The significance of this moraine becomes more evident after examining the north side of the river opposite. Here a high hill called Hark hill, stands far out into the valley in the angle between the Androscoggin and a stream that comes in from the N. N. W. Hark hill is separated from the cliffs that form the northern walls of the Androscoggin valley toward the north-west by a low valley in which is found an extensive moraine. This deposit ends on the east and north-east in a steep bank or bluff from twenty to forty feet high, overlooking the interval of the lateral stream above mentioned. It contains many angular bowlders and sometimes an angular gravel, as if little water worn. This deposit is not valley drift, and for the most part does not appear to be ordinary till. I marked it as a lateral moraine of the valley glacier, though not very positively. Its height was

not measured, but cannot be much, if any, more than one hundred feet above the river. No grooves of the local glacier could be found on the north side of Hark hill, though they are beautifully developed everywhere on the south side of the hill next the river.

On the south-east shoulder of Hark hill is found a morainal ridge. It bears N. 20° W., which was so near the direction of the flow of the continental glacier that I carefully examined the northern end of the deposit to see if it was a "tail" to a spur of the hill. It ends on the north at a height by aneroid of about one hundred and ninety feet above the river, terminating as a steep ridge of loose materials piled up to a height of ten or fifteen feet above the surrounding slopes of the hill. Its length is about one-fourth of a mile. It is evidently a moraine of the local glacier, and is described as such by Prof. Hitchcock.

Here then at this bend of the river, at the State line, are two remarkable moraines lying transverse to the valley and directly opposite to each other. Each begins at a point about two hundred feet above the river and reaches down nearly or quite to the upper terrace of the valley drift. The larger moraine is on the south side of the river, and almost in a line with the glacier's axis for a mile or two up the valley. It appears as if the local glacier here paused in its recession for a time long enough to form a terminal moraine of considerable size. That part of the moraine which was within reach of the swollen river would naturally be washed away or buried out of sight during the period of the deposition of the valley drift.

We have already referred to the lateral valley that comes from the N. N. W. past the north-east base of Hark hill. In the lower part of this valley is an arrangement of the modified drift which deserves notice. Here is a plain composed of steepish reticulated ridges of sand, gravel and pebbles, enclosing a small pond and numerous funnels. The external appearance of these ridges is decidedly kame-like. Their tops are on nearly the same level as the upper terrace along the river, and in fact they appear like an extension of the drift of the Androscoggin valley running back into this lateral valley for a half mile. They then drop down suddenly into a wide, level interval which reaches entirely across the valley and shows no distinct signs of terraces, at least on the south side. This interval shows hardly a pebble, nothing but a fine silt of great fertility. Time did not permit its exploration, but I was informed that it reaches two miles or more back from the river. For the first half mile from the river the lateral stream has eroded thirty or more feet into the valley drift and kame-like ridges, but its flood plain is not many rods wide. Then comes the wide interval, and although the stream meanders through it by several channels, yet the size of the interval, the fineness of its materials, and the absence of well-defined terraces,

make it very unlikely that this low flat was excavated in valley drift. At least, if so, the drift must have been of unusually fine materials.

The currents which deposited these kame-like ridges may have swept toward the Androscoggin valley or away from it. The abruptness with which the ridges end on the north-west, favors the latter theory, though this could not be confirmed by lines of stratification, as no fresh exposures could be found. At Shelburne the valley of the Androscoggin abruptly widens, and there has evidently been a lateral sweep of the currents, but I nowhere in the valley saw these oblique ridges actually turning back toward the west unless it be here at the State line. The appearances could be accounted for by supposing that during the deposition of the valley drift, in times of sudden flood, powerful currents overflowed into the lateral valley until it was filled with water. Coarse materials would be carried for a limited distance and the finer would be deposited over that wide interval, which would for the time being be a lake.' Or it may be that a part of these ridges were true kames, deposited in ice channels along the flanks of the valley glacier during its final melting. In any case it is difficult to see how the currents could have come from the north-west without leaving some traces of gravel ridges in that direction.

Thus far no decisive evidence can be found that the Androscoggin glacier flowed eastward of West Bethel. Many morainal ridges cross the valley but none of them appear to have been deposited by the local glacier, unless it be a line of hillocks and ridges just west of the valley of the Sunday river, below Bethel. A minute examination may show this deposit to be a moraine of the Androscoggin glacier.—*George H. Stone.*

MARSH ON JURASSIC DINOSAURIA.—In the March, 1880, number of the *American Journal of Science and Arts*, Prof. Marsh gives an account of the Dinosaurian *Stegosaurus ungulatus*, of which he has come into possession of an unusually complete skeleton. He finds the genus to be possessed of very distinctive characters, which are as follows:

"(1.) All the bones of the skeleton are solid; (2.) The femur is without a third trochanter; (3.) The crest on the outer condyle of the femur which in birds separates the heads of the tibia and fibula, is rudimentary or wanting; (4.) The tibia is firmly coössified with the proximal tarsals; (5.) The fibula has the larger extremity below." Prof. Marsh abandons the order *Stegosauria* which he formerly proposed, and refers the genus to the *Dinosauria*, to a special group. *Stegosaurus ungulatus* was thirty feet long, and walked on its hind limbs; its back was protected by bony scuta, and its food was probably vegetable.

ARCHÆOPTERYX.—In 1863 M. Häberlein discovered in the lithographic stone of Solenhofen (Bavaria) a fossil bird, the Archæop-

teryx, which was described by Owen, and a restoration of it is to be found in several of the recent manuals of Geology. More recently, M. Häberlein, Jr., has found in the same place another slab containing a complete and most perfect specimen of Archæopteryx. The examination of that specimen modified some previous conclusions. The wings are spread out as for flight. Two small, pointed, conical teeth are implanted in the upper jaw. The hands cannot be compared with those of a bird or of a pterodactyl; they resemble those of a three-fingered lizard. The fingers are long, slender and provided with sharp claws. The wing-feathers (remiges) are attached all along the outer side of the arm and hand; had they not been preserved, no one would have suspected, from the examination of the skeleton alone, that the animal was winged. The remiges do not overlap each other; the proximal end of the shaft is covered with down; the outline of the wings is rounded like that of the hen. The head, neck, chest, ribs, tail, thoracic girdle, and front limbs of that fossil are characteristically reptilian; the pelvis was also probably more reptilian than avian. On the contrary, the legs are bird-like; they resemble most those of the falcon, inasmuch as they are covered with feathers. To every caudal vertebra was attached a pair of lateral quills. The remainder of the body was evidently naked and featherless, with perhaps the exception of the base of the neck, where there are indications of a collar of feathers like that of the condor.

Karl Vogt, to whom science is indebted for several of the foregoing facts, says that it is superfluous to discuss the question as to whether the Archæopteryx is a bird or a reptile. It is neither; it is an intermediate type by itself, and confirms the views of Huxley, who classes together the birds and reptiles, under the name of Sauropsida, as one of the great divisions of vertebrates.

THE MANTI BEDS OF UTAH.—In a previous number (May, 1879) of this journal I showed that the palæontological evidence is opposed to the identification of the "Amyzon" beds of Nevada and Colorado with the Green River formation, and that the former are probably of later origin. There is, however, a series of calcareous and silico-calcareous beds in Central Utah, in Sevier and San Pete counties, which contain the remains of different species of vertebrates from those which have been derived from either the Green River or Amyzon beds. These are *Crocodilus*, sp., *Clastes cuneatus* Cope, and a fish provisionally referred to *Priscacara* under the name of *P. testudinaria* Cope. There is nothing to determine to which of the Eocenes this formation should be referred, but it is tolerably certain that it is to be distinguished from the Amyzon beds. In its petrographic characters it is most like the Green River, as it consists in large part of shales. The laminæ are generally thicker than those of Green and Bear River. The genera *Crocodilus* and *Clastes* have not been found heretofore in

Green River beds, although they are abundant in the formations deposited before and after that period. Until its proper position can be ascertained, I propose that the formation be called the Manti beds.—*E. D. Cope.*

The Skull of Empedocles.—This genus, originally described[1] from vertebræ, proves to be allied to *Diadectes*, and to be one of the most remarkable forms of the Permian fauna. With that genus it forms a family, the *Diadectidæ*. The skull of *E. molaris*[2] displays the following characters:

The relations of the quadrate and zygomatic arches are as in the *Theromorpha* generally. The pterygoids extend to the quadrates, and the vomer bears teeth. The brain-case extends to between the orbits, and its lateral walls are uninterrupted by fissures from this point to near the origin of the *os quadratum*. There is an enormous frontoparietal foramen. The mode of connection with the atlas is peculiar. There is a facet on each side of the *foramen magnum*, which then expands largely below them. The bone which bounds it inferiorly, presents on its posterior edge a median concavity. On each side of this, is a transverse cotylus, much like those of an atlas which are applied to the occipital condyles of the *Mammalia*. They occupy precisely the position of the Mammalian condyles. The median point of their upper border, which forms the floor of the foramen magnum, is produced in the position occupied by the median occipital condyle of a reptile. From its position between the cotyli, the section of this process is triangular. The element in which the cotyli are excavated has the form of the mammalian basioccipital, and of the reptilian sphenoid. It is not the batrachian parasphenoid. Its extreme external border on each side where it joins a crest descending from the exoccipital, is excavated by a circular fossa which looks outwards.

The character of this articulation is so distinct from anything yet known among vertebrated animals, that I feel justified in proposing a new division of the *Theromorpha* to include the *Diadectidæ*, to be called the *Cotylosauria*.

It will be remembered that in *Diadectes* the maxillary teeth are transverse, and molar-like. There is a distinct canine. In *Empedocles* there is no distinct canine, but the incisors are distinguished by their form, having more or less distinct transverse edges. For the present I refer *D. latibuccatus* to *Empedocles.*—*E. D. Cope.*

GEOGRAPHY AND TRAVELS.[3]

The Interior of Greenland.—The Danish Government having recently instituted an examination by a scientific commission of the interior of Greenland, has now published the first part of

[1] Proceed. Amer. Philos. Soc., Phila., 1878, p. 516.

[2] *Diadectes molaris* Cope, Amer. Naturalist, 1878, p. 565.

[3] Edited by Ellis H. Yarnall, Philadelphia.

a report giving the results of these researches. A recent number of the *Nature* (February 12, 1880) gives a *résumé* of the work, from which we take the following:

"The work contains four memoirs of great interest: an account of the expedition upon the inland ice, made by Lieut Jansen in 1878; a record of the astronomical and meteorological observations made during this journey; notes on the geology of the west coast of Greenland, by M. Kornerup; and remarks upon the plants collected by the last named explorer, by M. Lange.

"Starting from the neighborhood of Frederikshaab, in South Greenland, Lieut. Jansen traversed a distance of forty-six miles over the continental ice. Here he found, as did Dalager, who made a similar attempt from the same point in 1751, that a number of islands of rock (Nunatakker) rise above the general level of the great sea of ice, and upon these rocky islets no less than fifty-four species of plants were collected."

Of the character and movements of this great sheet of ice we learn that:

"1. At a distance of 75 to 76 kilometres from the shore, the continental ice attains a height of 1570 metres (5115 feet), and must be of considerable thickness, since its inclination to the east from the Isblink of Frederikshaab averages only 49′.

"2. On that part of the continental ice which has been explored, even at a great distance from the shore, are found many 'Nunatakker,' which influence to a great extent the movements of the ice, in some cases actually bringing about a reversal of the direction.

"3. The surfaces of dislocation resulting from the movement of the ice are almost vertical in the midst of the continental ice, but they incline at the edge and near the 'Nunatakker,' where the slope of the ground is great, and the upper parts of the ice, in consequence, move more rapidly.

"4. The crevasses are partly perpendicular, partly parallel to the direction of the movements, following the nature of the inequalities of the rocky bed, and in places where the ice takes a fan-like disposition, both radial and tangential crevasses are observed.

"5. Around the 'Nunatakker' and the rocks near the shore the surface of the continental ice is impregnated with fine rocky *débris* (sand and clay), which are brought there by tempests, and which brooks carry from a distance to the cavities of the continental ice. The masses of clay thus collected give rise to the pyramids of ice which, near the Isblink of Frederikshaab, attain an elevation of nearly sixty feet.

"6. Moraines of different form are found on the continental ice, especially near the 'Nunatakker,' and they must be referred to the classes of ground moraines and terminal moraines. They frequently form curved or semi-circular lines, and inclose well-

rounded masses of stone of no great magnitude, which in their advance fall into the crevasses."

The exposed rocks along the coast and in the islets which rise above the great ice-sheet are found to be mostly composed of gneiss, with some mica, talc and hornblende-schists, and occasional patches of granite.

New proofs are furnished of the gradual elevation in past periods of the west coast. "Five sets of raised beaches are described occurring at heights of 28, 57, 94, 192 and 326 feet above the sea-level respectively. On the other hand there is clear evidence that the land is, at the present time, slowly subsiding, the extent of this movement being shown to have been at Lichtenfels from six to eight feet since the year 1789."

FINSCH'S EXPEDITION TO THE NORTH PACIFIC.—Dr. Otto Finsch, a naturalist of wide reputation, having recently completed an account of his last journey through Western Siberia, has now undertaken to visit the less known islands of the Northern Pacific. He reached Honolulu in July last. He sends home an interesting account of the effect of the introduction of new species of plants and birds upon the native species. Large numbers of mainas, a kind of starling *(Acridotheres tristis)* have been imported from China, and by driving away the pigeons and fowls, and destroying the nests and eggs of the domestic birds, have become a great nuisance to the inhabitants. The mainas are very active and vociferous, and when gathering by hundreds at their roosting places, the noise is indescribable. The European house-sparrow has also reached the Sandwich islands, and are only second in numbers to the mainas. Another introduced species is the turtle-dove, brought also from China. To find the native birds it was necessary for Dr. Finsch to travel into the interior. Even here they were scarce, and he complains that both the native forests and birds are rapidly being destroyed. On August 21st, Dr. Finsch arrived at the Marshall islands, landing on "Jaluit," or Bonham island. This island being much visited by the natives of the other neighboring and little known islands, afforded him excellent opportunities for his ethnographic studies.

GEOGRAPHICAL NEWS.—A valuable paper, "Observations on the Physical Geography and Geology of Madagascar," accompanied by a physical sketch map, by James Sibree, Jr., was given in *Nature* for August 14, 1879. It contains much new and valuable information about this great island which is the third in size in the world, and nearly four times larger than England and Wales. —— *Nature* notices an amusing mistake in a German scientific work, "Das Leben der Hauskatze und ihrer Verwandten," where the following extraordinary statement occurs: "Die schwanzlose Katze von der Insel Man *im stillen Ocean* wenn nicht das *Kap Man auf Borneo* darunter zu verstehen," etc., thus first placing

the Isle of Man in the Pacific ocean and then doubting its existence, and suggesting it may be a cape of the same name in Borneo!!—— Accurate measurements made by the Russian authorities in the ports of the Baltic, have undoubtedly proved that the level of the sea at Cronstadt is, by nearly two feet, higher than at Reval, and that the height decreases regularly from north to south; this conclusion being fully supported by Prussian measurements at Memel and at Kiel.——The *Revue de Geographie* has recently published some statistics of the census of Japan. Only five cities have over 100,000 population, viz: Tokio 595,905, Ohosaka 271,292, Kioto 238,603, Nagava 125,195 and Kanazava 109,850. Yokohama has only 64,602 inhabitants, Nagasaki 29,660 and Hakodate 28,800.——In a communication to the London *Academy* (January 24, 1880) upon the archæology of Southern Italy, M. Lenormant well says, that "geographers have not hitherto paid sufficient attention to the general fact of the displacement of the centers of population throughout this region at the beginning of the middle ages. The Greek cities were all placed on the sea shore, or at a very short distance from it, in positions favorable to traffic by sea, but ill adapted for purposes of defence. During the centuries when Saracen corsairs were masters of Sicily, and periodically ravaged the coasts of Southern Italy, these positions became untenable, exposed as they were to devastation of every kind. The inhabitants abandoned them and withdrew some five or six miles from the sea, leaving the coast absolutely deserted." "Now, since security has returned to the coast, thanks to the suppression of piracy in Barbary, which continued to desolate these regions until the taking of Algiers by the French, a precisely opposite movement is in progress. The first step was to plant the sea-board and cultivate it afresh without leaving the inland districts. Next, within the last few years, the railway has been constructed which skirts the Ionian sea. Now the inhabitants are gradually descending from the towns built in the middle ages on the heights which, twenty years hence, with the exception of Catanzaro and Squillace, will be in turn almost deserted."——The results of a recent scientific exploration of Sumatra are to be given to the world in a magnificent work embracing four volumes. The geography of the country will be contained in one of these which will also include the meteorology and geology, while the other books will be devoted to the ethnology, natural history and languages of Sumatra and a narrative of the journey. The Dutch edition will first appear, but it will doubtless be translated into one at least of the more widely known languages.——The French Geographical Society are considering the practicability of adopting some uniform system of spelling in their publications, thus quickly imitating the similar resolution of the Royal Geographical Society.—— The New York State Survey has ascertained that in a dis-

trict covering about 2000 square miles, in one of the most populous parts of the State, and containing two important cities and nearly two hundred villages and hamlets, *every one* of these towns or villages is misplaced from one to two miles on all existing maps. The Director, Mr. James T. Gardner, remarks: "Colorado was not a greater surprise to me than has been the structure of my native State. In the study of the origin of some of the most remarkable features lie untrodden tracts of knowledge which are yet to awaken deep interest. The configuration of a part of Central New York is as unique and as unknown to science as that of any part of the Rocky mountains."——"Studien über das Klima der Mittelmeerländer," by Theobald Fischer, published as a supplement to *Petermann's Mittheilungen*, is an exhaustive monograph on the climate of the shores of the Mediterranean. An interesting account of the famous winds, the Maestral, the Bora and the Sirocco, is given with many tables and charts illustrating the records of temperature and rainfall. He also discusses the evidence for change of climate, within historic times, afforded by the fauna and flora. When the African elephant was tamed by the Carthagenians, the camel was unknown in North Africa, whereas now the camel is indispensable on the desert and the elephant and rhinoceros have both disappeared from the region. There is no evidence of such a change in the climate of the countries north of the Mediterranean as would prevent their recovering the position they held in ancient times. The rainfall, though, owing to the destruction of the forests, it is differently distributed, is the same in amount and sufficient for agricultural needs. In the countries, however, lying south of lat. 34° N. greater changes have taken place, the rainfall being decidedly less in amount than formerly. Vast tracts have become uninhabitable, the desert is ever encroaching upon the steppe, the springs are drying up in the oases, and the larger mammals are abandoning the region. Only a local influence could be exerted by the proposed inland sea in Algeria, but the planting of forests might produce greater results. ——Mr. Alexander Forrest, brother of the well-known explorer, Mr. John Forrest, has recently made a successful journey in north-western Australia, during which he explored the country lying between the De Grey and Victoria rivers. Starting February 15, 1879, from the former river and proceeding northwards to King's Sound, the party then followed up the Fitzroy river for a distance of 250 miles. It is navigable for small vessels for about 100 miles. Leaving the Fitzroy at 17° 42′ S. lat. and 126° E. long., they journeyed north-west towards Collier bay for 140 miles, ascending a table land 2000 feet high, but were obliged to return to the river, owing to the ruggedness of the country. They then, on July 10th, started for the overland telegraph line, marching in an E. N. E. direction, and reached the Victoria river near its junction with the Wickham, after a march of 340 miles.

During this part of their journey they discovered a vast extent of fertile country, abounding in grass, and intersected by numerous large rivers, all running north and north-west. Great numbers of natives were seen, and for the most part they were fine, big men, but they had evidently never seen Europeans before. Leaving the Victoria, they came to an almost waterless country, and after terrible sufferings finally reached the Katherine telegraph station. They arrived at Port Darwin on October 6, 1879.[1]

MICROSCOPY.[2]

AGENCY FOR EXCHANGING OBJECTS.—A Microscope Exchange Bureau has been opened by Herman Poole, No. 23 W. Swan street, Buffalo, N. Y. Slides are to be sent to the exchange in quantities of not less than six, and accompanied with a list of desiderata. One of each six will be retained by the agency, and the rest will be exchanged as requested, so far as may be possible.

EXCHANGES OF APPARATUS.—Several subscribers desire to make exchanges of apparatus. A Crouch student's monocular stand, and Schrauer binocular, and several choice lenses are offered, either for a Beck or Crouch binocular, or a Powell & Lealand large monocular, or for lenses of other powers, or for cash. Particulars can be obtained from the editor of the Department of Microscopy of the NATURALIST.

AMERICAN SOCIETY OF MICROSCOPISTS.—The executive committee of this Society have decided to accept the invitation received from Detroit, and the meeting next August will therefore be held in that city. The precise date is not determined at the time of this writing. It is certain that the citizens of Detroit will give a generous welcome to the Society; and a large and important meeting is expected. Correspondence in regard to papers to be offered, or other scientific business of the meeting, should be addressed to the president-elect, Prof. H. L. Smith, of Geneva, N. Y.

OBSERVATIONS ON THE CONSTRUCTION OF THE HUYGHENIAN EYE-PIECE AS USED IN MICROSCOPES.—The difference in the conditions under which the Huygenian eye-piece is used in the microscope, as compared with the telescope, for which it was first devised, and the adaptation of the eye-piece to those conditions, has received but little attention from microscopists, and there are discrepancies in the few statements published in regard to the subject. The following examination of some of the oculars now in use on microscopes was undertaken to determine whether their construction conformed to any general principles. The examination was made by means of a heliostat and focometer, by which the dismounted lenses could be arranged in any position with reference to each other. The lenses being arranged in the foco-

[1] For fuller details of this expedition see *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, 1879, p. 436.
[2] This department is edited by Dr. R. H. WARD, Troy, N. Y.

meter, light may be sent through them from an aperture of known diameter, and a piece of card or ground glass placed between the lenses at different points to indicate the course of the rays. For measurements, one of J. Moller's photographed micrometers, inserted as an object, is most convenient, the dense black blocks admitting of accurate reading, and the millimeter being a more convenient unit than the line. The magnifying power is ascertained according to the ordinary formula: Divide the product of the focal lengths by their sum diminished by the interval between them; *e. g.*, for the first in the table $30 \times 60 = 1800$, which, divided by $30 + 60 - 58 = 48$, the result being slightly too large.

	Maker and Name.		Focal length of eye lens	Focal length of field lens.	Diameter eye lens.	Diameter field lens	Distance, plane surfaces	Distance, lens to diaphragm	Aperture, diaphragm	Aperture in cap.	Ratio focal length eye lens to field lens.	Focal length eye piece	Do in inches (approximately)	Magnifying power
1	Beck's Popular.	A	30	60	18	29	53	34	18	7	[illegible]	48	2	4
2		B	21	42	11	24	37	22	15	7	[illegible]	33	1½	6
3		C	14	25	7	13	22	14	10	5	[illegible]	20	¾	15
4	Beck's Small Best.	A	30	60	18	30	55	32	18	7	[illegible]	51	2	4
5		B	20	40	11½	24	38	20	15	7	[illegible]	36	1¼	6
6		C	14	25	7	13½	24	18	10	5	[illegible]	23	1	10
7		D	8	16	6	12	18	13	8	2½	[illegible]	21	¾	15
8		E	6	12	5	11	11	8	7.	2¼	[illegible]	10	½	29
9		F	3	6	5	9	7	6	5	2¼	[illegible]	9	⅜	30
10	Orthoscopic		12	25	9	17	25	17	12	8	[illegible]	25	1	10
11	"		26	35	11½	31	37				[illegible]	38	1½	6
12	Nachet.	1	30	55	14	20	47	30	13		[illegible]	43	1½	5
13		2	20	38	13	20	35	18	13		[illegible] +	33	1½	7
14		3	10	32	10	20	30	17	10		[illegible]	26	1	10
15	Crouch.	A	32	55	18	28	52	35	20	10	[illegible]	50	2	4
16		B	26	36	12	24	37	20	18	8	[illegible]	37	1½	6
17	Oberhauser.	2	32	43	12	19	47	35	14		[illegible]	49	2	4
18		3	29	37	10	20	40	30	15		[illegible]	41	1¾	5

(All distances in millimeters except in the column marked "inches.")

By inspection of the table it will be seen that in half the oculars examined the ratio of focal length of eye lens to field lens is about one-half, in only one is it one-third, and in one of older construction they approach so near as seven-ninths. The general principle in regard to the interval separating the lenses is that it shall be less than the solar focus of the field lens though in the deeper oculars, and in the orthoscopic, this limit is approached or slightly exceeded. But it must be remembered that in combination with the objective the ocular receives diverging rays, and hence the actual focus of the field lens for such rays is beyond the eye lens. In the shallow oculars it will be seen that only the central portion of the eye lens is used.—*W. H. Seaman (abstract) in Nat. Mic. Congress.*

SCIENTIFIC NEWS.

— In a recent letter to Dr. Hayden, M. de Lapparent, President of the Société Geologique de France, writes that the Geological Society of France has resolved to celebrate the fiftieth anniversary of its foundation. This should properly occur on the 15th of March, but as the annual meeting takes place April 1st, the Society has decided that the two meetings shall take place at the same time. A report will be read of the part which the Society has taken in the geological progress of the last fifty years. After the meeting a banquet will be given by the French members of the Society to the foreign geologists who have been so good as to respond in person to the invitation to be present. M. de Lapparent speaks of the pleasant relations established with foreign geologists by the meeting of 1878, and hopes that these relations will be further increased in 1880, and that much may be done to render the meeting at Bologna, in 1881, still more interesting and important.

— The dispute between the Directors of the Park Commissioners and the Permanent Exhibition Company of Philadelphia having been settled to the satisfaction of both parties, the latter will at once proceed to carry out its plan as a combination of museums. The close of last year saw a balance of $16,000 in its treasury, and it is believed that next year a considerable increase in the fund available for scientific purposes, will be made.

— Mons. A. Robin (Préparateur à la Faculté des Sciences), Rue d'Ulm, 38, Paris, France, is now preparing a general work upon the anatomy of the *Chiroptera*, and wishes to obtain, either by exchange, or otherwise, American material in this order of mammals.

— According to the *Academy*, C. Kegan Paul & Co., London, have published a memoir of the late Dr. Phillip P. Carpenter, well known as an able naturalist as well as philanthropist and sanitary reformer.

— The Academy of Science at Turin has awarded a prize, amounting in value to about £480, to Mr. Charles Darwin for his discoveries in the physiology of plants.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences, February 16.—Dr. R. P. Stevens remarked on the geology at the head of the Ten-mile branch of the Blue river, Colorado, and Mr. W. E. Hidden exhibited and described two new meteorites from the Southern States.

March 1.—Prof. E. C. Spitzka made a communication on the brain of man and of the ape, their resemblances and their differences.

BOSTON SOCIETY OF NATURAL HISTORY. February 18.—Mr. E. R. Benton spoke on the Brighton "amygdaloid," and Dr. Wm. M. Davis on the stratified amygdales in the Brighton amygdaloid, while Prof. N. S. Shaler remarked on the origin of the various classes of lavas.

March 3.—Prof. G. H. Stone read a paper on the kames of Maine.

MIDDLESEX SCIENTIFIC FIELD CLUB, Malden, Mass, January 7.—Prof. E. A. Dolbeare, of College Hill, Mass., read a paper on radiant energy and its effects. Radiant energy, with Prof. Dolbeare, is synonymous with the terms heat, light, etc.

February 4.—Herbert A. Young, of Revere, Mass., read a paper on insectivorous plants, illustrated by diagrams.

CALIFORNIA ACADEMY OF SCIENCES, Jan. 11, 1880.—President Davidson in the chair. Mr. B. B. Redding read a paper on "The Buried Treasures of our Remote Ancestors." Prof. Davidson made a verbal communication announcing the results of the Coast Survey Expedition for the observation of the late Solar Eclipse.

Feb. 2.—President Davidson in the chair. Mr. Stillman read the chemical analysis of a secretion of the *Parrya mexicana*, the greasewood or creosote plant, caused by the puncture of an insect; also analysis of the oil of the California laurel or bay tree. J. P. Moore announced that a catalogue of the Fungi of California was about to be published by Dr. Harkness under the auspices of the Academy. Dr. Behr read a paper on the gradual change of the Flora of the San Francisco peninsula, and on the supplanting of the native growths of all countries by those of Europe and Africa, especially the former.

March 1.—Prof. David S. Jordan gave an account of the labors of the Fish Commission on the Pacific coast. Prof. Stillman read an article on the gum and coloring matter found on *Acacia greggi* and *Larrea mexicana*. There was a discussion on the Metric System.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

THE CANADIAN ENTOMOLOGIST.—February. On certain species of Satyrus, by W. H. Edwards.

THE GEOLOGICAL MAGAZINE.—February. Mr. Hill on the cause of the glacial epoch, by James Croll.

ANNALS AND MAGAZINE OF NATURAL HISTORY.—February. On some blind Amphipoda of the Caspian sea, by Dr. Oscar Grimm.

ZEITSCHRIFT FÜR NATURWISSENSCHAFTLICHE ZOÖLOGIE.—January 23. On the development of the skull of the salamanders, by Ph. Stöhr. On the central nervous system of the crayfish, by K. R. Krieger. On the convolutions of the cerebral hemispheres of the zono-placental mammals, by J. Krueg.

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THE STRUCTURE AND ACTION OF A BUTTERFLY'S TRUNK.

BY EDWARD BURGESS.

EVERY one knows that butterflies and moths, the insects forming the group Lepidoptera, often feed on honey, and that for the purpose of obtaining it, they are provided with a long trunk, or tongue as it is sometimes called, to reach the nectaries of flowers. Sometimes this trunk is very long, in the case of our common tomato caterpillar moth, for example, its length is three inches, while in some allied moths of tropical regions it is greatly longer, and botanists and entomologists have often pointed out the relation existing between the length of various long-tubed flowers and of the trunks of some species of moths in the same region.

Thanks to the acuteness of Savigny, entomologists have long known that this trunk is not an organ *sui generis*, but simply the metamorphosed *maxillæ*, or second pair of jaws of biting insects, which have become specialized to form a sucking tube. The mandibles or first pair of jaws, which, while the insect was in the caterpillar stage were well developed to bite off pieces of leaves or other substances then its food, are, in the perfect butterfly, reduced to the merest rudiments (Fig. 1, *md*), only to be found by carefully brushing away the thick covering of scales and hairs. The pair of maxillæ, on the contrary, grow each into a long, gently-tapering organ with a deep groove along its inner surface; which surface being applied to that of the opposite maxilla, and held in this position by a sort of dove-tailing lock, there is formed a hollow trunk through which liquid food can be drawn into the mouth.

When not in use the trunk is coiled into a close spiral, and lies beneath the insect's head, hidden between the large and hairy feelers of the lower lip—the labial palpi—which are specially developed for this service.

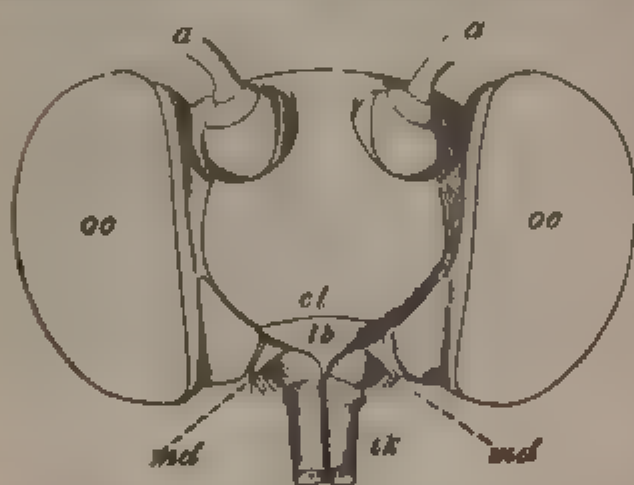


FIG. 1.—Face of *D. archippus*; *oc*, compound eyes; *a*, antennæ; *cl*, clypeus, *lb*, labrum or upper lip; *md*, the small mandibles armed on the inner edge with stiff bristles; *tk*, base of the trunk.

Now although, as just said, these facts have long been known, the mechanism for sucking liquids through the trunk seems never to have been noticed, and it has been supposed that the power of suction lay in the "sucking stomach," so called, or perhaps in the peristaltic contraction of the trunk, or that simply the capillary action of the latter might be sufficiently powerful to dispense with any special sucking apparatus. The anatomy of the trunk has been equally neglected and misunderstood. Thus even Burmeister believed that each half had a canal of its own, and Newport described non-existing horizontal muscles, and otherwise mistook the muscular mechanism.

FIG. 2.—Tip of trunk of *D. archippus* from outside, greatly magnified. The rings are really black and opaque, the intervening spaces delicate and transparent.

Having been for some time engaged in studying the anatomy of the "emperor," as Mr. Scudder has christened *Danais archippus*, our largest and very common butterfly, I will describe the mouth organs of this species, the same plan of structure prevailing through the whole group of Lepidoptera, at least wherever I have examined representatives

In the "emperor" then, the trunk is about fifteen millimeters long, with a width at the base of about $\frac{2}{3}$ mm, from which it gradually tapers to a point at the tip. Externally a sort of coat-of-mail appearance is given by its composition of an immense number of rings (Fig. 2) (or rather portions of rings, the inner segments being of course wanting) which being united by more yielding parts of the cuticle, evidently permit the rolling up of the whole organ, while imparting at the

same time the necessary stiffness. The rings are not perfectly regular, but vary in width and are here and there broken, or branch and anastomose.

Figure 2 shows a few of their irregularities, but they are less apparent at the tip than higher up. With a strong magnifying power the rings are seen to be made up of little plates[1] soldered together, except on the front surface near the inner edge of the maxilla, where the plates become separated and more or less hexagonal. Dotted over the whole surface, but more thickly at the tip, are seen little circular plates with a minute transparent papilla in the center. These are believed to be metamorphosed hairs, and in some butterflies and moths become greatly and peculiarly developed,[2] and are supposed by Fritz Müller to be organs of the sense of taste or touch, perhaps both. Breitenbach, however, thinks they play the part of teeth on a saw or file, and serve to tear the delicate flower tissues for obtaining the sweet juices contained in them. In the famous orange-sucking moth (*Ophideres fullonica*), which sometimes greatly damages the orange harvests, Mr. Francis Darwin[3] has described the remarkable armature at the tip of the trunk, which enables the moth to pierce even the thick skin of an orange, and one set of the curious spines in this case are simply our small papillæ much developed and specialized. These

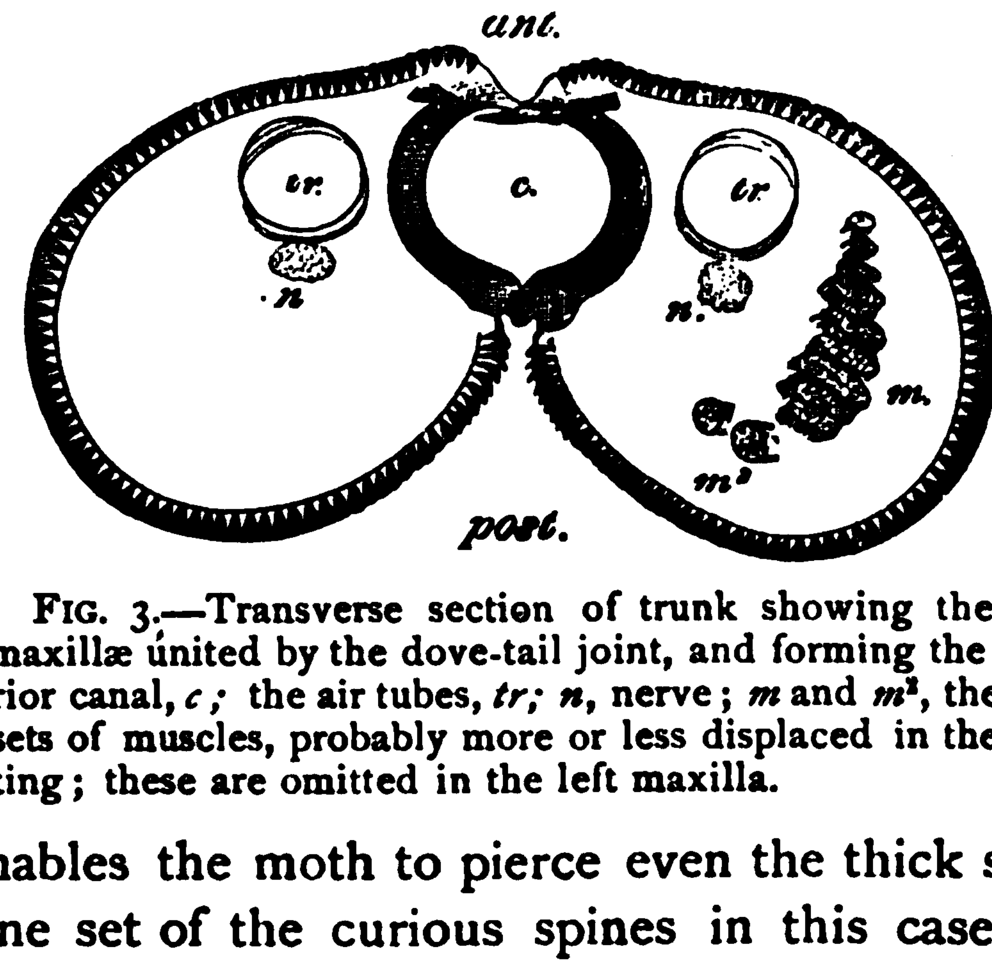
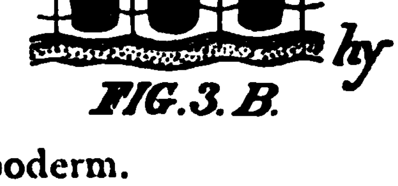


FIG. 3.—Transverse section of trunk showing the two maxillæ united by the dove-tail joint, and forming the interior canal, *c*; the air tubes, *tr*; *n*, nerve; *m* and *m*², the two sets of muscles, probably more or less displaced in the cutting; these are omitted in the left maxilla.

[1] By examining Figs. 3 and 4 it will be evident that these plates are the bases of little pyramid-shaped bodies (in some regions more like stout nails or tacks) which are imbedded in, or rather specialized portions of, the cuticle. Three of these are shown in the annexed figure, 3 *B*, where *cu* is the cuticle, plainly laminated, and *hy* the underlying matrix or *hypoderm*. It is not improbable that each pyramid corresponds to a single cell of the hypoderm.



[2] See papers by Breitenbach in Katter's Entomol. Nachr., v, 238, and in the Arch. Mikros. Anat., xv, 8 and xvi, 308.

[3] *Quart. Jour. Micr. Sci.*, xv, 385.

hair structures in the emperor, however, are not prominent enough, one would think, for mechanical action, and in this and similar cases, their function is probably wholly that of touch or taste. This view is strengthened by their occurrence also *within* the tube, where they appear, but in lesser numbers.

If we imbed the trunk in a mass of paraffine or soap,[1] and cut some thin transverse sections, we shall obtain with the microscope a view of its structure as seen in Fig. 3. Each half of the trunk, that is, each maxilla—has a sort of moon-shaped section, the lower horn of which is snugly dovetailed to the lower horn of the opposite half, while the upper horns are drawn out into long processes, which simply interlace like the fingers of one hand with the other. There is thus inclosed a central canal open from base to tip of the trunk, and its walls are made up of broad but thin, semicircular plates, whose narrow edges give the canal wall, seen from the side, much the appearance of a large trachea, or air-tube (Fig. 4, *c*). Each half of the trunk also contains a real air-tube (*tr*, Figs. 3 and 4), a nerve (*n*) and two sets of muscles (m^1 and m^2), while the rest of the space is filled out with connective tissues.

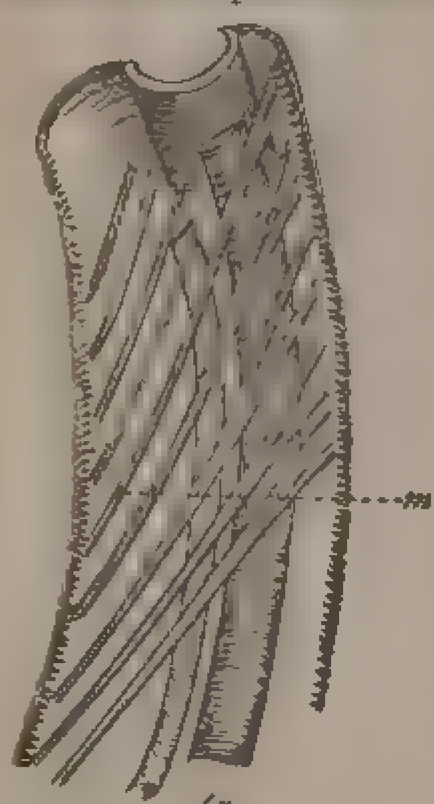


Fig. 4. — Longitudinal section of trunk; the canal, *c*, is shown above, lower down the trachea, *tr*, and the nerve, *n*, while the diagonal muscles, *m*, overlie them. These are spaced somewhat wider than in nature, for the sake of clearness. The right edge is the outer one.[3]

It has generally been believed[2] that the trunk is extended by muscular action, being rolled up in repose by its own elasticity, like a watch-spring, but the trunk muscles seem, at first sight, to be arranged for just the opposite state of things. They are grouped in two sets in each half of the trunk, each set arising on the anterior surface, and proceeding diagonally downward and backward to be inserted on the posterior surface. They converge too, in this course, so that, viewed from in front, the two sets of muscles form a series of V's one above the other. One of the sets is seen in the vertical section of the right maxilla (Fig. 4), and if we examine this

[1] See directions given by Dr. C. S. Minot in the NATURALIST for April, 1877.

[2] This is the statement of the latest text-book, that of Graber, die Insecten, I, 156.

[3] The cross sections of the rings forming the edges of the figure are engraved as much too irregular. The inner boundary of the cuticle is also omitted.

figure, it would seem that by the contraction of the muscles, the posterior side of the trunk is pulled upwards, and of course shortened, and the shortening taking place along the whole side, the result would be the spiral rolling up of the trunk, with the posterior side within the coil. These diagonal muscles are the only ones to be found, and Newport certainly errs in speaking of annular muscles. On the view of the muscular action just taken, it is evident that the trunk must be unrolled and extended by its own elasticity, and not the reverse, a theory which is certainly very questionable, but at present I am unable to offer a better, and must leave the point to the decision of future investigators. Certainly no writer I have found has thrown the least light upon the subject, or even given a correct general description of the muscular arrangement.

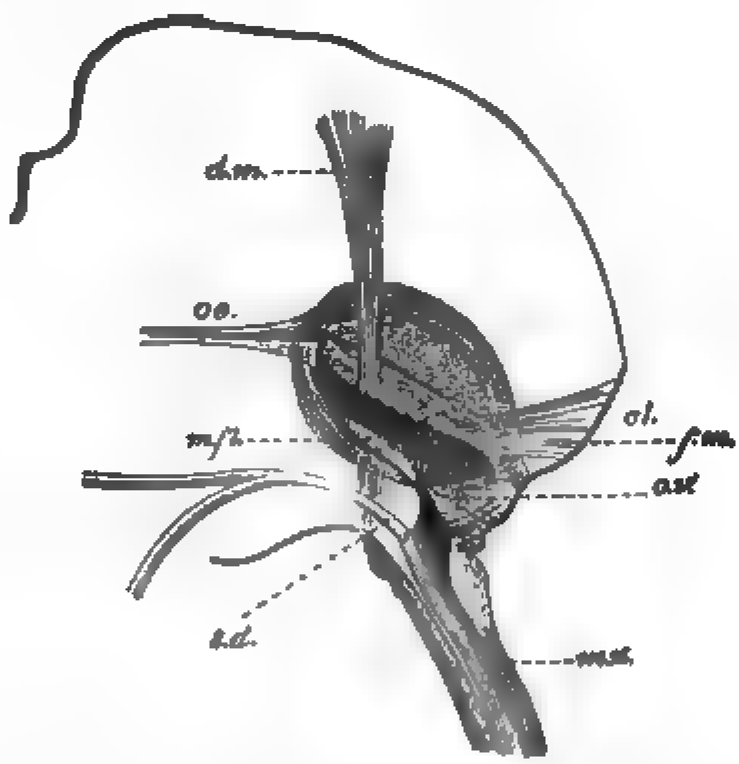


FIG. 5—Longitudinal section through the head giving a view of the interior of the left half; *mx*, the left maxilla whose canal leads into the mouth cavity; *m fl*, floor of the latter showing some of the papillæ of taste; *oe*, œsophagus; *cl*, clypeus; *ov*, oral valve; *sd*, salivary duct; *dm* and *fm*, a dorsal and the frontal muscles which hold the oral sack in its position.

At the base of the trunk large muscular bands run into it from the head in a diagonally opposite direction to the trunk muscles, and are inserted on the anterior surface. Their contraction of course pulls the whole trunk-coil closely up under the head.

Following now the trunk canal upwards into the interior of the butterfly's head, we find (Fig. 5) that it ends in what we may here call a mouth cavity, which is laterally expanded, but has no great diameter from front to back, that is, from palate to floor. The mouth cavity lies in a muscular sack (Fig. 6, seen from above), which is suspended within the head by five muscles, a lateral pair (*lm*), a dorsal pair (*dm*) and one frontal (*fm*). This oral sack is composed of muscular fibres running in a variety of directions as will be seen in Fig. 5; Fig. 6 shows the exterior appearance of the organ and its suspending muscles; the slender

œsophagus (*oe*) is seen entering it from above and behind. From the palate, just above the origin of the trunk, projects a triangular muscular flap, which we may call the oral valve (Fig. 5, *ov*) as it serves to close the mouth.

The floor of the mouth is made of a thick chitinized crust, with a longitudinal furrow between two convex regions; the floor thus somewhat resembles in shape the human breast. Each convexity is dotted over with minute transparent papillæ, which are, in general, similar to the papillæ already described, on the surface of the trunk. It seems highly natural to regard the papillæ, in this situation at least, as taste organs, but I have not succeeded in recognizing their nervous connection.

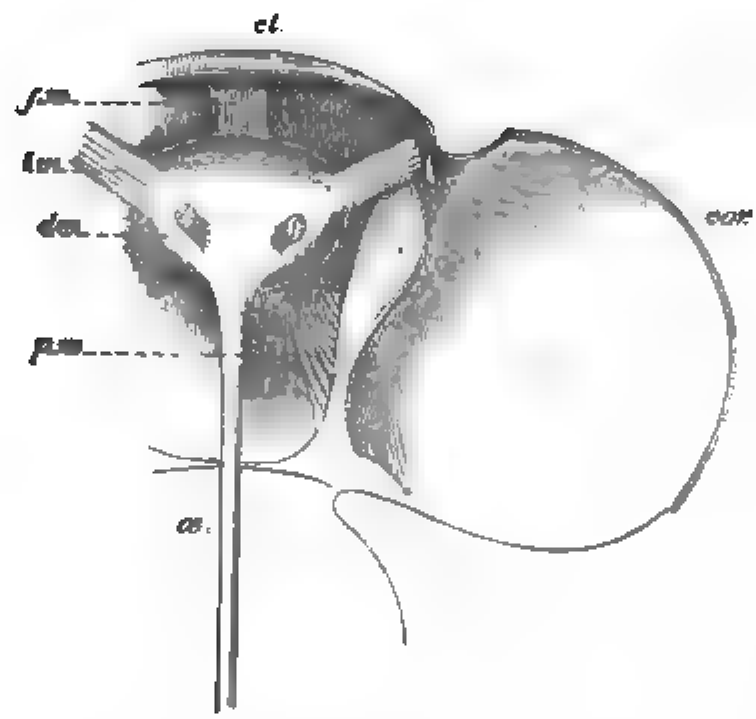


FIG. 6.—Interior view of the bottom of the head, the top having been cut away, showing in the middle the oral sack hung by its five muscles—the frontal, *fm*, the dorsal pair, *dm*, and the lateral pair, *lm*; *cl*, clypeus; *cor*, cornea of the compound eye (the left eye is not drawn); *oe*, œsophagus; *pm*, one of the large muscles which move the labial palp.

The palate of the mouth, unlike the floor, is lined with a delicate membrane. The suspensory muscles of the oral sack pierce the muscular wall of the latter and reach the palatal membrane. Their contraction would evidently draw the palate away from the floor of the mouth, thus enlarging its cavity. At the base of the trunk, on its lower surface, the common duct (*s d*) of the two lateral salivary glands opens as is shown in Fig. 5.

From the anatomy of these parts we may understand that the butterfly obtains its food in the following manner: The trunk is unrolled and inserted in the nectary of a flower; at this moment the muscles which suspend the oral sack contract, and the mouth cavity is thus extended, creating a vacuum which must be supplied by a flow of honey through the trunk into the mouth. When the mouth is full the muscular sack contracts, the oral valve closes the aperture to the trunk and the honey is forced

backward into the œsophagus. The mouth cavity is then again opened and the same process repeated. To prevent the food being sucked back from the œsophagus, it is probable that some of the numerous fibres in the muscular sack near the origin of the former can, by contraction, close its opening, but in any case as the trunk presents a free tube, and the œsophagus leads into the closed alimentary canal, it is evident that the former offers the easiest route for a supply to fill the mouth vacuum.

In the muscular mouth sack, we have thus a pumping organ, of action too simple to be misunderstood. As for the so-called "sucking stomach," its delicate membranous structure is certainly not adapted for sucking functions, and it probably serves only as a reservoir. It is usually found to contain nothing else than air, but Newport asserts that immediately after feeding food is also found in it.

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THE CRITICS OF EVOLUTION.

BY J. S. LIPPINCOTT.

THERE is a large class of minds even among those who esteem themselves educated, who have no acquaintance with science and another, perhaps equally large, who have no idea of what is meant by the scientific spirit. These all imagine, perhaps, that the world of things or phenomena around them, has ever been pretty much as it now appears to the superficial gaze, and that men have always known about as much about the earth, its origin, development and productions, as they now know. They appear to be unconscious of the fact that a century ago we knew almost nothing of the constitution of matter, and were holding the same crude and puerile ideas about nature that were held by the ancients 3000 years ago. They do not seem to be aware that but few conquests, from the domain of the unknown had been made in physical astronomy, and that almost all our knowledge of the composition of the earth and its myriads products, animal, vegetable and mineral, have not yet been reached.

A century ago the simplest phenomena were inexplicable; no

man knew why he breathed, or why a candle burned; why a plant grew; what use a leaf served; what the air is composed of; or that water is a compound fluid. A century ago, many more than even now-a-days, were perfectly indifferent as to the nature of things around them, regarding them, shall we say, with brute "unconscious gaze."

Why this ignorance of nature? The science of chemistry, a new revelation of the wisdom of the Creator, had not yet dawned upon the childhood of ignorance. When men began to question nature in the scientific spirit, began to weigh and measure and to question again and again while doubt rested upon her replies, they entered upon the path of discovery. This path has since been ardently pursued by hundreds of minds, qualified for the noble task of explaining His ways in the earth, by elucidating the method He is employing daily around us and within us, and by which He has ever been laboring for the good of His creatures. By following the path of research, accumulating facts, collating them, and constructing theories that would most fully account for the interdependence of the phenomena observed, man has penetrated into the mysteries of creation and in some directions already stands almost upon the brink of "the unknowable," beyond which it is impossible for finite minds to go. As each grand generalization has prepared him to take a new stand-point, and from thence to obtain a wider view of natural phenomena, his conceptions have become more comprehensive, until he may yet grasp the origin of the universe and been enabled to understand the laws by which it was condensed from the all pervading nebulous condition which has been termed chaos.

Many we are aware denounce theories as vain imaginings; but such should learn that a theory is but an expression of the relations of phenomena, a condensed presentation of all the facts in their natural order, and that it is by this artificial memory the enquirer is enabled to grasp his attainments, and to be lifted up as by a scaffolding for the more thorough study of new phenomena, otherwise incomprehensible, and for the construction of a building which shall embody all the truth. Theories, let it be understood, are always tentative, always a working apparatus, to be remodeled as knowledge advances, and indispensible to its progress. Theories are not, as many suppose, the offspring of imagination purely, but are like a figure cast within a mold, or like a casting perfectly

shaped thereon. The mold upon which theories are formed is the mass of facts observed in their just relations, as far as man has yet discovered and determined.

Emboldened by his success, the man of science is pursuing the path of discovery, convinced that though there may be many things beyond his comprehension, there is nothing that he should consider beyond his enquiries. Bacon in his "Advancement of Learning," sagely advises, "Let no man out of a weak conceit of sobriety, and an ill-applied moderation, think or maintain, that a man can search too far, or be too well studied in the book of God's word or in the book of God's works; divinity or philosophy; but rather let men endeavor an *endless* progress or proficience in both." It is in the highest degree probable that the Creator designed he should follow this path, both for the further development of his intellectual powers and for the promotion of the cause of truth and righteousness in the earth. It is evident that our enlarging conceptions of creative power, widen the avenue through which we receive impressions of the Divine glory, and that the views of the educated modern scientist are infinitely expanded beyond the narrow confined range of the ancients. His new and grander generalizations of knowledge are indeed so many wonderful revelations of the Creator, who, as it were, thus speaks almost face to face with man.

Unfortunately many minds, especially those of purely theological bias, appear to be incapable of comprehending the value of the grand results that have followed scientific research. They hastily dismiss them, with the remark—all these researches are merely material—"of the earth, earthy," and beneath the consideration of beings living in a spiritual world and destined to an eternity of spiritual existence. This estimate of the importance of the labors of men of science, whose studies have given us almost all the comforts and invaluable appliances that have lifted us above our semi-civilized ancestors, appear to us, to be a very unworthy and very superficial view. The progress of civilization is intimately connected with, is indeed dependent upon, advance in the useful arts, which are founded directly upon science, and to reject science and contemn its advocates, is to spurn one of the chief factors in the work of human elevation.

Among the grand generalizations or results of the labors of naturalists of recent date, is that entitled Evolution, which is in-

deed the noblest product of a century of scientific thought; the top-stone of the intellectual building that man has been erecting.

Scientists falsely assumed to be Atheists.—Though it is not a part of the mission of science to explain or even to discuss the supernatural, philosophers readily admit, that all *real origination* is supernatural. The question is whether they have yet gone back to the origin, and can assert indubitably, that the present forms of plants and animals are those originally created by miraculous exercise of power. Studying facts and phenomena in reference to proximate causes, or endeavoring to trace back the series of causes and effects as far as possible, is a process strictly scientific and perfectly legitimate. It is the process of all science. Did not Newton, by this method, rise from the observation on the fall of an apple, to the far-reaching discovery of the laws of gravitation? Let it be observed also as in the highest degree instructive in this connection, that Newton, the pious Sir Isaac, the demonstrator of the truth of prophecy, a sincere and humble believer in the leading doctrines of our religion,—was because of his demonstration of the laws by which the universe is sustained, pronounced by the ignorant and unwise ultra-pious of his day, *an atheist.*[1] They hastily assumed that, because the philosopher had traced the working of the Divine hand, had demonstrated the method by which He labors, that God had been shut out of the creation. Here is something more foolish than any philosophy, and paralleled only by the reasoning of our champion Anti-Evolutionists.

The path pursued by Newton is that followed by Darwin, who has adhered to the scientific spirit, deeming the task of science to be, as expressed by Agassiz, "to investigate what has been done, to inquire if possible *how it has been done*, rather than to ask what is possible for the Deity, since we can know that only by what actually exists." Though Darwin has not deemed it his duty to become an exponent of natural theology, *he has emphat-*

[1] The list of those who have been denounced as infidels and atheists, include almost all great men of science—generals, scholars, inventors, philanthropists. The deepest Christian life, the holiest Christian character, have not availed to shield the combatants. Christians like Sir Isaac Newton and Pascal, and John Locke and John Milton, and even Howard and Fenelon, have had these weapons hurled at them. "*The Warfare of Science*," by Andrew D. White, LL.D., President of Cornell University. See also lists of persons charged with infidelity and atheism in "Le Dictionnaire des Athées." Paris, An. VIII. (1799)

ically contradicted the base charge brought against him that "he does not recognize and does not admit either Divine agency or Divine supervision in furnishing, or in peopling the world." This view is nowhere expressed in his books. I believe he nowhere uses the phrase "fortuitous conjunction of circumstances," which some of his critics "roll as a sweet morsel under their tongues," nor can his language "natural selection" be rightly construed to mean any such fortuitous conjunction;" nor does he "sneer at the idea of any manifestation of design in the material universe." Darwin maintains that the origination of a *species*, no less than that of an *individual* is *natural.* He has also defined his meaning of the word *natural*, and asserts, choosing the language of the distinguished Bishop Butler, whom none will deny was thoroughly orthodox,[1] "The only distinct meaning of the word '*Natural*,' is, stated, fixed, or settled, *since what is natural as much requires and presupposes an intelligent agent to render it so—that is—to effect it continually or at stated times*—as what is supernatural or miraculous does to effect it for once."

This passage from Butler Darwin has placed at the very portal of his work "The origin of species by means of natural selection or the preservation of favored races in the struggle for life,"—upon the reverse of the title page, where it should be the first to meet the eye of the reader.

Here is an emphatic acknowledgment of belief in Divine agency, a recognition of intelligent supervision throughout the "processes of evolution." It is no part of our mission to account for the vagaries of the critics friendly to Darwin, who have misconstrued his principles. He must speak for himself, and he has here spoken in unmistakable language.

Evolution Generally Accepted.— Few of the objections that sprang into life the moment the doctrine of development was proposed for our acceptance, now give evidence of persistent vitality. Time has consigned, or is consigning, them to oblivion, and "evolution is taking its place as part of the furniture of the human mind."

[1] "Analogy of Religion natural and revealed to the constitution and course of nature," by Joseph Butler, Lord Bishop of Durham. This passage appears in chap. 1 of Part I. on Natural Religion, on p. 105 of Harper's edition of Bishop Butler's Analogy of Religion, &c. The following succeeds it in order and is quite pertinent to the present discussion. "And from hence it must follow, that persons' notions of what is natural will be enlarged, in proportion to their greater knowledge of the works of God and the dispensations of His Providence."

Like other accepted theories, evolution is the natural growth of closer and deeper observation, and therefore of more accurate knowledge of the relations of facts. The doctrines of evolution have been reached in the perfectly legitimate manner by which all the other great truths of science have been discovered. It has been a natural outgrowth from facts, and is not, as some suppose, an invention sprung from the imagination of a dreamer. It is one department of "that science which is but common sense methodized and extended," and "is indeed the highest stage of human knowledge."

It has appeared to us to be a reasonable opinion that any one endowed with the scientific spirit would not go to a theologian to obtain a just estimate of the value of a scientific theory, but would visit an enlightened expert for an opinion. "The former class continually labor to make tradition confront discovery and feel constrained to view with jealous distrust the rapid advancement of practical knowledge." Their inquiries are not whether any new fact is absolutely true, but whether it is in accordance with conceptions they consider established. Those who really desire to learn what evolution is, and its profound significance, and are possessed of the proper faith in nature as a revealer of intellectual truth, will not consult Joseph Cook's "Biology," the scientific charlatanry of which has been thoroughly exposed in the *New Englander* for January, 1879, where its taste and rhetoric have been pronounced "execrable," and which in the *Saturday Review* is the subject of an article entitled "*Spread Eagle Philosophy.*" With his religious sentiments properly, we have no controversy. Nor would they look with any confidence upon the objections of writers whom they should no more regard as authority on scientific questions than they incline to accept their views on theology. Dr. Hodge, of Princeton, has been well answered by Dr. Gray in his "Darwiniana,"[1] to which I would refer the reader. One of his remarks may as well here be reproduced; "It may be well to remember that of the two great minds of the 17th century, Newton and Leibnitz, both profoundly religious as well as philosophical, one produced the theory of gravitation, the other objected to that theory, that it was subversive of natural religion; also that the nebular hypothesis, a natu-

[1] What is Darwinism? by Charles Hodge, Princeton N. J. By Asa Gray in his Darwiniana, pp. 266–282, and pp. 137–258.

ral consequence of the theory of gravitation and of the subsequent progress of physical and astronomical discovery, has been denounced as atheistical even down to our day. It has now outlived anathema," and is no longer rejected even by theologians.

Dr. Asa Gray acknowledges that Darwin in his style is loose, and that he might have been more guarded had he chosen to be so. Dr. Gray, however, acquits him of all atheistic intent, and remarks that his view may be made clear to the theological mind by likening it to that of the "believer in the general but not in particular Providence," a view which prevails among mankind.[1] There is no need, says Gray, "to cull passages from his works to support this interpretation, while the author—the most candid of men—retains throughout all the editions of the "Origin of Species," the two mottoes from Dr. Whewell and Bishop Butler, which, by implication, entirely acquit him of atheism.

It may be well to quote the passage from Dr. Whewell, the able author of "A History of the Inductive Sciences;" that from Butler has already been adduced: "But with regard to the material world, we can at least go so far as this—we can perceive that events are brought about not by insulated interpositions of Divine power exerted in each particular case, but by the establishment of general laws." (Whewell's Bridgewater Treatise.)

Another extract from Dr. Gray we will present the reader. In physical and physiological treatises, the most religious men do not think it necessary to postulate the First Cause, nor are they misjudged by the omission. But surely Darwin does acknowledge a Creator, not only by implication but most explicitly where one would most naturally look for it, namely—at the close of the volume in question. "Authors of the highest eminence seem to be fully satisfied with the view that each species has been independently created. To my mind it accords better with what we know of the *laws impressed on matter by the Creator*, that the production and extinction of the past and present inhabitants of the world, should have been due to secondary causes, like those determining the birth and death of the individual" * * * "there is grandeur in the view of life, with its several powers, having been *originally breathed by the Creator* into a few forms, or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless

[1] Darwiniana, p. 258.

forms most beautiful and most wonderful have been and are being evolved."[1] "If these expressions," says Dr. Asa Gray, "do not refer the efficiency of physical causes to the First Cause, what form of words could he use."[2]

The Teleology of Evolution.—One of our objecting critics forgets that he is quoting from an old work of Huxley's, where he says "that which struck me most forcibly was the conviction that teleology (the science of Final Causes) had received its death blow at Darwin's hands."

To the above I may reply, following Dr. Gray and other able defenders of Darwinism, that as regards the old teleology, the less said in its defense the better for the cause of religion. The difficulties which its principles will not explain are many and serious.[3] Darwinian teleology has the special advantage of accounting for the imperfections and failures which have loaded the doctrine of teleology with far more than it could bear. The Darwinian teleology not only accounts for the failures and the successes, but it turns them to practical account. In Darwinism we have a teleology that accords with, where it does not explain, the principal facts, and is free from the common objections. The Darwinian system, as we understand it, coincides with the theistic view of nature; it not only acknowledges purpose, but builds upon it. It understands all nature to be of a piece, and it is clear, therefore, that design is in some way mixed up with it. If adaptation and utility are the marks of design, what then, we would ask, are the organs not adapted to use the marks of?—and there are numerous functionless organs in almost every species of animal. Man has sundry perfectly useless parts which the old teleology cannot account for, and which are great stumbling blocks in the way of the olden style natural theologians. But evolution shows their true place and *demonstrates that these structures are relics of a former state of being.* "It is," says Haeckel,[4] precisely this widespread and mysterious phenomenon of rudimentary organs, in regard to which all other attempts at explanation fail, which is

[1] "On the Origin of Species by means of Natural Selection," &c. By Charles Darwin. New York, 1873. New edition from the sixth English edition, &c., pp. 428, 429.

[2] Darwiniana. By Dr. Asa Gray. Pages 370, 378, 379.

[3] Darwiniana. By Dr. Asa Gray. Pages 268, 269.

[4] "The *History of Creation;* or the Development of the Earth and its Inhabitants by the action of Natural Causes," by Ernst Haeckel. 1876. Vol. I, p. 16.

perfectly explained, and indeed in the simplest and clearest way, by Darwin's 'Theory of Inheritance and Adaptation.'"

These remarks could be greatly extended, with vivid demonstration, but I must content myself with referring to an admirable popular work by William D. Gunning, entitled "*Life History of our Planet*," where one may learn that the human body is a "library of anatomical history." Finally, I adduce the testimony of Dr. McCosh, an unimpeachable witness, who asserts that, "the doctrine of development does not undermine nor in any way interfere with the argument from design."[1]

Dissent of Agassiz.—Much stress has been placed upon the dissent of Agassiz and Dawson from the views of the evolutionists, and they are quoted as veterans who of course we are bound to regard as speaking *ex cathedra*, and therefore not to be gainsayed. "Have any of the rulers or of the Pharisees believed on him? was asked of old," and some critics ask the same question and forget that it is recorded of Christ, "For neither did his brethren believe in him." What to the seeker for truth does it matter now or did it matter then, who believed or now believes? The votaries of science are not swayed by authorities but by truth. Their motto should ever be, "Nullius addictus jurare in verba magistri." The opinions of aged men, unless they have kept themselves abreast of the thought of the day, are frequently unwise, and are seldom regarded by those who prefer to seek truth for its own sake regardless of the reflections of Mrs. Grundy. "By the time," I have heard a most eminent man of science observe, "by the time a man of science attains eminence on any subject he becomes a nuisance upon it, because," if advanced in age, "he is sure to retain errors which were in vogue in his youth, but which the new race has refuted. These are the sort of ideas that find their home in *Academies*, and out of their dignified windows pooh-pooh new things." (Bagehot's Physics and Politics, p. 60.)

Science enjoys perpetual youth. Her votaries grow old and pass away, and their opinions with them, unless founded on eternal principles. "Her goal to-day is her starting point to-morrow." It is an historical fact that no physician over forty years of age at the time of the discovery of the circulation of the blood

[1] "Is the *Development Hypothesis* Sufficient," by Dr. James McCosh, President of Princeton College. Published in the *Popular Science Monthly*, Vol. x, p. 96.

by Harvey, ever believed in that discovery. Why did they not believe in it? Because it was not in accord with their inherited prejudices, with the experience of their lives, and their personal pride scouted at the discovery, by a young man, of valuable facts that they ought themselves to have seen long ago, were they true. Thus it was with Agassiz, who ought to have seen the truth of evolution long ago, for he contributed a large body of material for the verification of the theory. His embryological discoveries offer conclusive evidence of its truth. This his pupils saw, but their master, blinded by his Cuvierian education and belief in distinct specific creations, could never reach the truth, though dissatisfied with the hypothesis of creation as recorded in Genesis. He published a theory of distinct creations in many separate geographical centers, and was, therefore, quite heretical. The doctrine of evolution covers all this ground more satisfactorily, and his theory is disregarded. Why was this master in research incapable of impressing his views upon his pupils, with whom he was personally so popular? Because young and unprejudiced they sought truth for its own sake, and loved it better than even they did their admired teacher. His opposition to Darwinism, they now openly assert, served to make them more careful in their scrutiny into its weak points as described or imagined by him, and he was thus of real service in training his pupils for the adoption of the doctrine of evolution. "Of all the younger brood of naturalists whom Agassiz educated, every one—Morse, Shaler, Verrill, Niles, Hyatt, Scudder, Putnam, even his own son—has accepted evolution." (*Popular Science Monthly*, Feb., 1880.)

In direct opposition to palæontological experience, that many species of organic beings have continued unchanged through successive periods of the earth's history, while others have existed during only a small portion of such a period, Agassiz maintained that one and the same species never occurs in two different periods, but that each individual period is characterized by species peculiar thereto and belonging to it exclusively. In this he shares Cuvier's opinion that all the inhabitants of successive geological formations were annihilated by the revolutions which divide two periods of the earth's palæontological history, and that a new and specifically different assemblage of organisms was created and suddenly placed upon the earth in large numbers by the Creator. "Pines," says Agassiz, "have originated in forests,

heath in heather, grasses in prairies, bees in hives, herring in shoals, buffaloes in herds and men in nations."[1]

The present terrestrial fauna of Australia is acknowledged to be unique, and is it not essentially a remnant of the fauna of the Jurassic or even of an earlier age? "There is a wonderful relationship," says Darwin, "in the same continent between the dead and the living." On the hypothesis of evolution there is no difficulty in admitting that the differences between the Miocene forms of Mammalia and those which exist at present, are the results of gradual modification. "The hypothesis of evolution explains the facts of Miocene, Pliocene and recent distributions," says Huxley, "and no other supposition even pretends to account for them."

The division of the Tertiary into Eocene, Miocene, Pliocene and Post-pliocene according to the preponderance in number of extinct or recent shells, evidently admits that many species have persisted through the changes that have destroyed others.

The late T. A. Conrad, a pronounced opponent of evolution, asserts in his "Descriptions of new Genera and Species of Fossil Shells of North Carolina,"[2] that "it is a generally received opinion that some species of Miocene shells escaped the destruction of the general fauna," and that "the small amount of variation, and in *some species none at all*, seems to indicate that some few kinds of shells are now living which originated in the Miocene period." "Among these shells, the *Oliva litterata* (Lam.) lives in myriads in Tampa bay, whilst there is a Miocene *Oliva* equally abundant in the bank of Cape Fear river, which offers no characters by which to distinguish it from that fossil species." The same remark is made respecting the fossil *Marginella limatula* (Conrad), a species living on the coast of South Carolina, while he suspects identity of the fossil and the living may be shown to exist among many other species.

In his paper on "The Relations of the Horizons of Extinct Vertebrata of Europe and North America," Prof. E. D. Cope has shown that "the characteristic of the Pliocene fauna in Europe is the fact that the species belong mostly to existing genera." "In the Equus beds of Oregon, a few extinct genera in like manner share the field with various recent ones, while not a few of the

[1] Essay on Classification. Contributions to Natural History of the United States. By L. Agassiz. Vol. I. p. 39.

[2] "Report of the Geological Survey of N. Carolina," by W. C. Kerr. 1875. Appendix A, p. 24.

bones are not distinguishable from those of recent species" Thus the bones of the fossil beaver and wolf cannot be distinguished from those of the recent, while they are also associated with the remains of an extinct fossil elephant, horse and llama. The species derived from the cave formations of the Eastern States, which Cope names the Megalonyx beds, also present many instances of extinct species mixed with the remains of those represented by the living ground-hog, porcupine, hare and rabbit and from which they cannot be distinguished.

In further illustration of this error of Agassiz, we may also cite the continued existence of the *Lingulæ*, formerly included among mollusks, but now shown to be allied more closely to worms. The *Lingulæ* were numerous and important in earlier geological ages and have been continued almost from the dawn of life and as they exist in the primordial "are scarcely to be distinguished as even Prof. Dawson acknowledges[1] from those of the members of the genus which still live." The original *Lingulæ* were remarkable for the presence of phosphate of lime in their shells, a peculiarity not found in the shells of mollusks generally, which are hardened by the presence of carbonate of lime. The modern *Lingulæ* present the same peculiarity and exhibits the wonderful persistence with which they adhere to the original type.

It was the merit of Agassiz that he drew especial attention to the remarkable parallelism between the embryonal and the palæontological or the development through time and the development of organic species, genera and tribes, which is claimed as one of the strongest pillars of the theory of descent or of evolution. No one before had so distinctly stated as Agassiz did, that of vertebrate animals, fishes alone existed at first, that amphibians came next, and that birds and mammals appeared only at a much later period, and moreover that among mammals, as among fishes, imperfect and lower orders had appeared first, and more perfect higher orders at a later period. He thus showed that the palæontological development of the vertebrates was not only parallel with the embryonic, but also with the systematic development or the graduated series which we see everywhere is ascending from the lower to the higher classes, orders, &c. *Haeckel.* This doctrine is explained quite simply and naturally by the doctrine of descent, or a historical succession, and without it, is perfectly in-

[1] "The Story of the Earth and Man," by J. W. Dawson. 1873. p. 41.

explicable. "So far as Agassiz's work, entitled 'An Essay on Classification,' pretends to be a scientific history of creation, it is undoubtedly a complete failure."[1]

We are indebted to a paper entitled "Agassiz and Darwinism," by John Fiske, in the *Popular Science Monthly*, Vol. III, for most of the following remarks upon the cause of Agassiz's inability to perceive the truths of evolution.

The frequency with which the name of Agassiz has been brought before the American people through his contributions to geology, palæontology and systematic zoōlogy, has rendered his name very popular, and given rise to the opinion that he was the greatest of naturalists. He by right occupied a very high position, but no exceptional supremacy can be rightly claimed for him. Both for learning and for sagacity, the names of Asa Gray, Prof. Wyman, Huxley, J. D. Hooker, Sir Charles Lyell, Ernst Haeckel and Gegenbauer, are quite as illustrious as the name of Agassiz, and these are the names of men who openly endorse and defend the Darwinian theory. Many imagine that because Agassiz studied extinct and living organisms through a life-time of research, that his opinions with reference to the relations of present life upon the globe to past life, ought to be conclusive. The distinguished Darwinian naturalists above named, are equally well qualified to form an opinion, and have arrived at conclusions diametrically opposite to those taught by Agassiz. Why this result? Not because Agassiz did not possess the power of philosophizing, but because he philosophized on unsound principles. He erred because his philosophy was not the natural outgrowth from the facts of nature, which lay at his disposal, but is made up out of sundry traditions of his youth, and because he long ago brought his mind to acquiesce in various generalizations of a thoroughly unscientific or non-scientific character, the further maintenance of which appeared to him to be incompatible with the Darwinian theory. He also evidently arrived too early at that rigidity of mind which prevents us from properly comprehending new theories, and which we should all of us dread as a real evil. It has been broadly asserted by a learned writer familiar with the Darwinian controversy, that he has never met with any indication that Agassiz knew what the Darwinian theory really is! "Against a development as it was taught forty years ago he was fond of

[1] "The History of Creation," by Ernst Haeckel. Vol. I., p. 70.

uttering his expressions of dislike, but with the modern development theory he never betrays the slightest acquaintance, but contents himself with making profoundly dark metaphysical phrases do the work which properly belongs to observation and induction."

[*To be continued.*]

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HALL'S SECOND ARCTIC EXPEDITION.[1]

OF the many men who have won fame in Arctic exploration, none have manifested greater heroism and perseverance than Charles Francis Hall. His ardent faith, which persuaded him to believe in the existence of some member of the lost expedition of Sir John Franklin at as late a period as twenty years after the abandonment of the *Erebus* and *Terror*, sustained him amidst the perils and hardships and disappointments of nearly eight years of life amongst the Esquimaux. Alone, with very slender means, he was yet able to obtain much important information regarding the fate of the officers and crews of that most unfortunate expedition, and to add materially to our geographical knowledge of the regions bordering upon the Cumberland gulf and the Bay of Hudson.

The story of his last voyage in the *Polaris*, and his death at almost the furthest Northern point yet reached by explorers is well known. Of his first journey, in 1860–62, to the Cumberland gulf and Frobisher's bay, he has given us a full account in his "Arctic Researches." But until now no account has been given to the public of his longest and most successful journey. This occupied a period of five years and six months, and upon his return home he began immediately his preparations for his North Polar expedition, and was unable to prepare an account of his travels. Fortunately his journals and notes, mostly carefully made and preserved, were in the possession of his family, and were purchased from them by the Navy Department under an

[1] Narrative of the Second Arctic Expedition made by Charles F. Hall. His voyage to Repulse bay, Sledge Journeys to the Straits of Fury and Hecla and to King William's Land, and Residence among the Eskimos during the years 1864–'69. Edited under the orders of the Hon. Secretary of the Navy by Prof. J. E. Nourse, U. S. N. U. S. Naval Observatory.

Act of Congress, and these, with his private correspondence, form the basis of the narrative now published by the National Government.

Prof. J. E. Nourse of the Naval Observatory, who, upon the death of Admiral Davis, completed for publication the "Narrative of the North Polar Expedition," was ordered to prepare this work, and has performed the duty assigned him most successfully, showing wise discrimination in the condensation and selection of the material laid before him, and great industry and careful

Ebierbing.

Too-koo-li-too.

research in the collection of information relating to previous Arctic explorations.

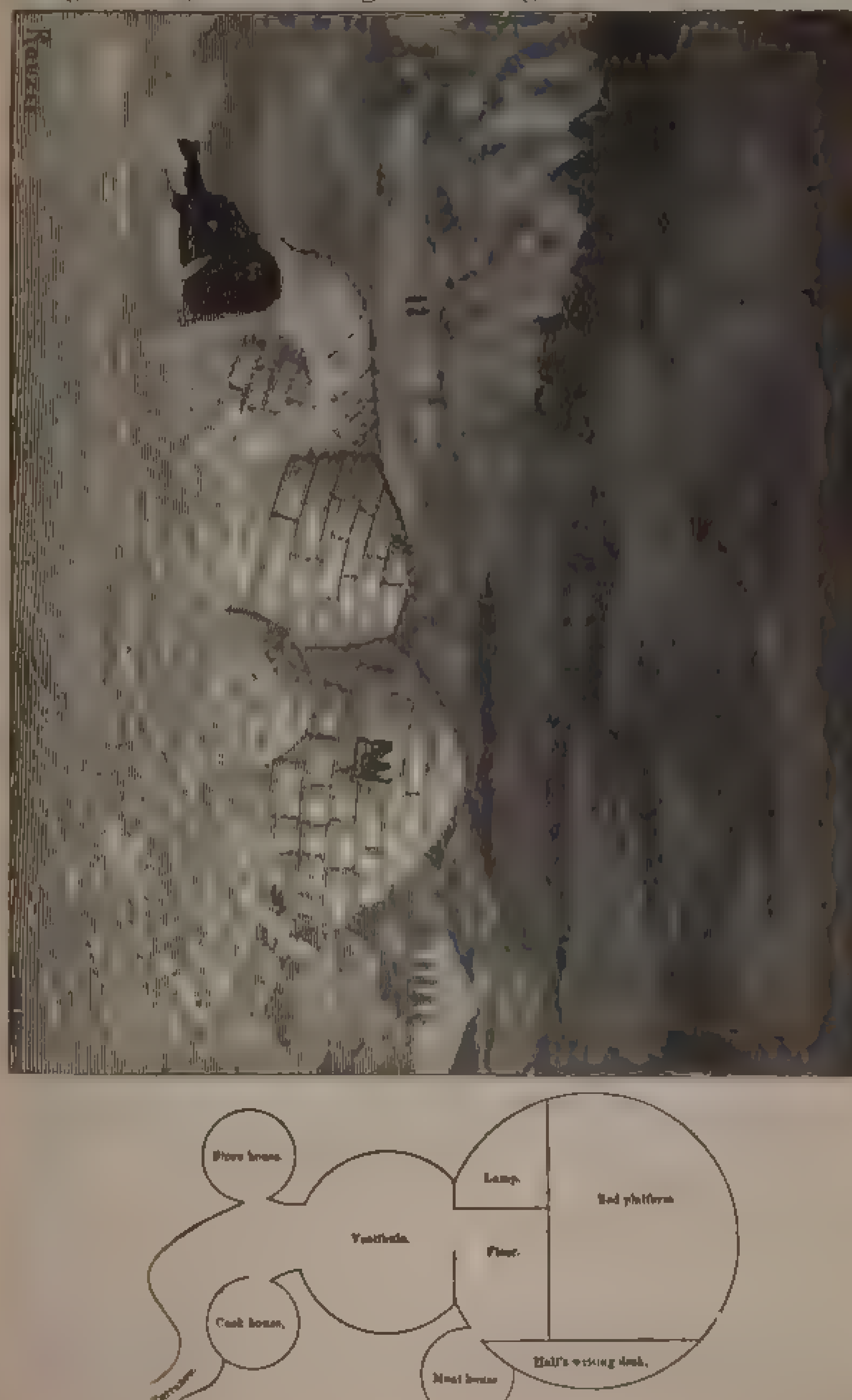
In a preliminary chapter, tables are given showing all the English and American explorations for the north-west passage, from 1818 to 1845, when Sir John Franklin's expedition left England, and also the English and American Franklin relief expeditions from 1848 to 1860, and mention is also made of the geographical and scientific results of these voyages. There is also

an interesting account of two voyages made from Philadelphia in 1753–'54, by a schooner of about sixty tons, fitted out by subscription by merchants of Maryland, Pennsylvana, New York and Boston to discover the Northwest passage.

Although Capt. Hall on his first voyage was unable to reach King William's Land or obtain any definite information regarding the records of the Franklin Expedition, he returned home inured by the hardships of life amongst the Esquimaux, and well prepared by this experience for the much greater trial of his courage and perseverance which awaited him. After nearly two years spent in efforts to obtain funds and supplies, he again sailed on July 1, 1864, in the whaling brig *Monticello* for Hudson's bay, taking with him the Esquimaux, Joe Ebierbing, and his wife, Too-koo-li-too. After stopping at Depot island, he finally landed at a point on the shore of Roe's Welcome, near Wager bay, on the 31st of August. He was obliged to remain in this neighborhood with a tribe of Innuits all winter, living in an igloo or snow hut.

"The construction of one of these snow houses, built by the Innuits of this region, is described by him substantially as follows: After making trial of several banks of snow, by plunging in their long knives, on finding the proper compactness, they cut blocks two to two and a-half feet in length and about eighteen inches in thickness. One set is cut from the spot on which the *igloo* is to be built, its floor being thus sunken eighteen inches below the general surface. In placing the blocks around this excavation, of about ten feet diameter, the first tier is made up of those which, by increasing regularly in width, form a spiral from right to left. They are laid from within, each being secured by a bevel on the one last laid and another bevel on the next one below. The joints are well broken. The blocks incline inwardly, thus regularly diminishing the diameter of the *igloo* and fitting it for the dome or keystone. Thirty-eight blocks were here used. For ventilation, a small hole is usually made by the spear. The crevices are well filled with snow within and without, making it nearly an air-tight structure. For a window, a small opening cut in the dome is filled in usually with a block of clear ice; in some cases with the scraped inner linings of the seal; this last makes a light on which the frost does not settle as upon the ice-blocks. The passage-way to the *igloo* is always long and points toward the south. The Repulse bay natives shovel up much more snow upon the hut than the Greenlanders do. The *igloo* lamp is sometimes nothing more than a flat stone, about six inches in length, placed in a niche cut out of the wall, and having on it a little dry moss for a wick, which is supplied with oil by a slice of blubber from

the bear or the seal. A stone lamp of better form, although poor enough, will give something of a fair light and warmth."



Hall's first Igloo and Ground Plan.

During the next summer he succeeded in reaching Repulse bay, where the winter of 1865–66 was passed, and it was not until April, 1866, that he was able to start for King William's Land with a small party of natives, three sledges and eighteen dogs. On leaving Fort Hope, at the head of Repulse bay, he followed, as nearly as practicable, Dr. Rae's route in 1854, to Colville bay. From here, however, he was obliged, most reluctantly, to return to Fort Hope, owing to the hostility of the tribes occupying the region around Pelly bay and the timidity of his own people. He was, however, able to obtain much interesting information concerning the Franklin expedition.

"Disappointed but not dismayed" is his entry in his journal on his turning back from Colville bay, although he knew another winter must elapse before he could hope to reach the goal of his journey—the island which witnessed the destruction of the memorable expedition. The remainder of this year was passed in the neighborhood of Repulse bay, the loneliness of his life being much relieved by the arrival and detention over the winter of four whaling ships.

Interesting accounts are given of the superstitious customs and amusements of the Esquimaux. One of the latter is the performance on the *key-low-tik*, their bass drum, the only musical instrument Hall found among them. "The drum is made from the skin of the deer, which is stretched over a hoop made of wood, or of bone from the fin of a whale, by the use of a strong braided cord of sinew passed around a groove on the outside. The instrument weighs about four pounds." The wooden drum stick is called a *ken-toon*.

"When the *key-low-tik* is played, the drum-handle is held in the left hand of the performer, who strikes the edge of the rim opposite that over which the skin is stretched. He holds the drum in different positions, but keeps it in a constant fan-like motion by his hand and by the blows of the *ken-toon* struck alternately on the opposite sides of the edge. Skillfully keeping the drum vibrating on the handle, he accompanies this with grotesque motions of the body, and at intervals with a song, while the women keep up their own Innuit songs, one after another, through the whole performance.

"At the first exhibition which Hall witnessed some twenty-five men, women and children—every one who could leave home—assembled to see the skill of the performers, who would try the newly-finished instrument. As usual, the women sat on the plat-

form, Turk fashion; the men behind them with extended legs. The women were gaily dressed. They wore on each side of the face an enormous pig-tail, made by wrapping their hair on a small wooden roller a foot in length, strips of reindeer fur being wrapped with the hair. These were black and white for those who had sons, and black only for those who had none. Shining ornaments were worn on the head, and on the breast they had masonic-like aprons, the groundwork of which was of a flaming red color, ornamented with glass beads of many colors. The

Playing the Key-ow-tik.

women thus presented a pleasing contrast with the dark visages of the men in the background; while their naked infants were playing here and there in a mother's lap, or peering out from their nestling place in a hood."

February and March, 1867, were spent in a journey of more than one hundred miles to Ig-loo-lik to procure dogs. He was successful in this but suffered much from cold and hunger, and on his return to Repulse bay was again, to his bitter disappointment, obliged to relinquish his expedition to King William's Land.

The captains of the whaling fleet, notwithstanding their previous promises, now refused to spare him any of their men for this journey.

His courage and perseverance were, however, equal to the situation, and he resolutely declined to return home in the autumn. A fourth winter found him still in his igloo at his old quarters. But his attention was now suddenly diverted from King William's Land to the northern extremity of Melville peninsula on the shore of Fury and Hecla strait where he now heard of the existence of a monument, and was told that two white men had been seen there only three years before. Accordingly on March 23, 1868, he started for this region. The monument was discovered on the 24th of April in lat. 69° 47′ 5″ N., long. 85° 15′ W., near Cape Crozier. "On either side of the plain on which it stands is a river, and hills of delta are north-east of it. It is one hundred feet above the sea, and near a hill upon the south side of the plain." "The spot visited had not been reached by any previous Arctic explorer. Parry's officers were not on this western side of the peninsula, and Dr. Rae's highest point was 69° 5′ 35″ N. (Rae's Narrative, p. 128)." "Dr. Rae could not possibly have made this monument and cache, for they both belong together; the latter covered with a deep drift every winter, and when Rae was at Cape Crozier in May 1846, the bank of snow must have been as deep and hard as the one now there. Besides, Dr. Rae's track-chart does not show that he visited the south-east angle of Parry bay."

The spot, near by where the Innuits stated a cache had been made and afterwards removed, leaving the stones in a pile on one side, was covered by a huge bank of snow, and after digging to the depth of fifteen feet they were unable to find the stones. Two tenting places also were found, one of which being very different in character from the other made by Esquimaux, was in all probability the work of white men. Hall took down the monument, stone by stone, but found nothing to indicate who were its builders.

The heretofore unsurveyed coast line between Capes Englefield and Crozier was now accurately laid down. An island was discovered north-west of Cape Englefield, and the islands off the cape and the line of the southern coast as far as East cape searched thoroughly for monuments or the evidences of the presence of

civilized men. After a sledge journey of ninety-six days he returned to Repulse bay on June 26.

The winter of 1868–9 was spent in resting and preparing for his last and successful attempt to reach King William's Land. He set out once more, on March 23, 1869, for this remote island with

Snow Village.

a party of natives consisting of five men, three women and two children, with two sledges and eighteen dogs, and followed the route previously taken in 1866 to Colville bay. Thence crossing Pelly bay he visited an encampment of natives of that region finding there some relics of the Franklin expedition.

Continuing on to the coast near Point Acland, opposite King William's Land, he found another native settlement where a large number of articles from the *Erebus* and *Terror* were seen. Leaving most of his party here he started on May 8, with one of the tribe as a guide, on a flying visit to King William's Land, his people insisting on returning to Repulse bay within two weeks. On the 11th, Hall encamped on one of the Todd islands off the southeastern extremity of King William's Land. Searching here for human remains no satisfactory result was obtained, but the next day, crossing to the mainland near the mouth of the Peffer river, and digging through the snow, one unburied skeleton was found. "The gale above and the hardness and depth of snow under foot debarred further search." He also searched with no success at another point on the southern coast, further eastward. He was then obliged to return to his party, and after some interesting conversations with the natives set out on his return journey, having thus been only able to touch at two points on the coast of King William's Land and at Todd island, and that too at a season when the snow still covered the land.

On the return journey he was seized with a sudden and serious illness, a premonition, no doubt, of the sudden and final attack in 1871. He reached his old quarters restored to health on June 20th, his arrival being delayed by the large quantities of game found and the frequent musk-ox hunts. When a band of musk cattle was discovered and surrounded, "as soon as they perceived that the dogs were slipped, they formed into their usual one circle of defense, 'a musk-bull battery of nine solid battering heads and twice the number of sharpened horns.' The dogs were quickly at these heads, barking and jumping back and forward, while the hunters made no haste to advance, for they knew that the bulls would stand their ground all day if no other enemies came.

"'After a few minutes' watch of the movements of dog versus bull and bull versus dog,' the old hunter, *In-nook-poo-zhee-jook*, went forward to within twelve feet of a large bull, carrying a lance which had a line attached by which he could draw it back; but at his second throw the wounded and infuriated bull made a fearful forward plunge, from the effects of which the hunter and his companions escaped only by a very timely jump to the left. The bull was soon again brought to bay. *Ou-e-la* then pulled trigger on another noble bull of the circle of defense, and *Pa-pa*

shot the one which had been lanced, when at the noise of these guns the whole circle bolted away except two, who stood their ground side by side long after the whole fight was ended, and even when the dogs were driven away from them and stones had been thrown. Instead of moving, each of these two kept throwing his massive head down between his fore feet, rubbing the tip of each horn against the fore leg as one would rub a razor on a strop. This is the animal's habit unless he finds himself, when attacked, near some large stone which he may use for the same purpose of sharpening his horns."

On August 5th the whaler, *Ansell Gibbs*, arrived in the bay, and his five years of Arctic life came to a close. On September 26, 1869, he, with Esquimaux Joe, Hannah and her adopted child, were safely landed at New Bedford, Mass.

Having thus briefly indicated the most important events in this remarkable journey, we must note the at least partial success attained in the execution of the purpose for which it was undertaken.

While no records of the Franklin expedition were recovered, there were many new facts ascertained regarding the last days of the members of that wretched company who perished one by one, after the abandonment of the *Erebus* and *Terror*. As is well known these vessels were deserted by their officers and crews, then consisting of 105 souls, on the 22d of April, 1848, off Point Victory near the north-western extremity of King William's Land. Capt. Hall in writing to Mr. Henry Grinnell, states:

"None of Sir John Franklin's companions ever reached or died on Montreal Island. It was late in July, 1848, that Crozier and his party of about forty or forty-five passed down the west coast of King William's Land in the vicinity of Cape Herschel. The party was dragging two sledges on the sea-ice, which was nearly in its last stage of dissolution: one a large sledge laden with an awning-covered boat, and the other a small one laden with provisions and camp material. Just before Crozier and party arrived at Cape Herschel, they were met by four families of natives, and both parties went into camp near each other. Two Eskimo men, who were of the native party, gave me much sad but deeply interesting information. Some of it stirred my heart with sadness, intermingled with rage, for it was a confession that they, with their companions, did secretly and hastily abandon Crozier and his party to suffer and die for need of fresh provisions, when in truth it was in the power of the natives to save every man alive.

"The next trace of Crozier and his party is to be found in the skeleton which McClintock discovered a little below, to the south-

ward and eastward of Cape Herschel; this was never found by the natives. The next trace is a camping-place on the sea-shore of King William's Land, about three miles eastward of Pfeffer river, where two men died and received Christian (?) burial. At this place fish-bones were found by the natives, which showed them that Crozier and his party had caught while there a species of fish excellent for food, with which the sea there abounds. The next trace of this party occurs about five or six miles eastward, on a long, low point of King William's Land, where one man died and was buried. Then, about south-south-east, two and a half-miles further, the next trace occurs on Todd's islet, where the remains of five men lie. The next certain trace of this party is on the west side of the islet, west of Point Richardson, on some low land that is an island or part of the main land, as the tide may be. Here the awning-covered boat and the remains of about thirty or thirty-five of Crozier's party were found by the native *Poo-yet-ta*, of whom Sir John Ross has given a description in the account of his voyage in the Victory in 1829–'34.

"In the spring of 1849, a large tent was found by the natives whom I saw, the floor of which was completely covered with the remains of white men. Close by were two graves. This tent was a little way inland from the head of Terror bay. In the spring of 1861, when the snow was nearly all gone, an Eskimo party, conducted by a native well known throughout the northern regions, found two boats, with many skeletons in and about them. One of these boats had been previously found by McClintock; the other was found lying from a quarter to a half mile distant, and must have been completely entombed in snow at the time McClintock's parties were there, or they most assuredly would have seen it. In and about this boat, beside the skeletons alluded to, were found many relics, most of them similar in character to those McClintock has enumerated as having been found in the boat he discovered.

"I tried hard to accomplish far more than I did, but not one of the company would on any account whatever consent to remain with me in that country and make a summer search over that island, which, from information I had gained from the natives, I had reason to suppose would be rewarded by the discovery of the whole of the manuscript records that had been accumulated in that great expedition, and had been deposited in a vault a little way inland or eastward of Cape Victory. Knowing as I now do the character of the Eskimos in that part of the country in which King William's Land is situated, I cannot wonder at nor blame the Repulse bay natives for their refusal to remain there, as I desired. It is quite probable that, had we remained there as I wished, no one of us would ever have got out of the country alive. How could we expect, if we got into straitened circumstances, that we would receive better treatment from the Eskimos

of that country than the 105 souls who were under the command of the heroic Crozier some time after landing on King William's Land? *Could* I and my party with reasonable safety have remained to make a summer search on King William's Land, it is not only probable that we should have recovered the logs and journals of Sir John Franklin's Expedition, but have gathered up and entombed the remains of nearly 100 of his companions; for they lie about the places where the three boats have been found and at the large camping-place at the head of Terror bay and the three other places that I have already mentioned. In the cove, west side of Point Richardson, however, nature herself has opened her bosom and given sepulture to the bones of the immortal heroes who died there. Wherever the Eskimos have found the graves of Franklin's companions, they have dug them open and robbed the dead, leaving them exposed to the ravages of wild beasts.

"I could have readily gathered great quantities—a very great variety—of RELICS of Sir John Franklin's Expedition, for they are now possessed by natives all over the Arctic regions that I visited or heard of—from Pond's bay to Mackenzie river. As it was, I had to be satisfied with taking upon our sledges about 125 pounds total weight of relics from natives about King William's Land. Some of these I will enumerate:

"1. A portion of one side (several planks and ribs fast together) of a boat, clinker-built and copper-fastened. This part of a boat is of the one found near the boat found by McClintock's party. 2. A small oak sledge-runner, reduced from the sledge on which the boat rested. 3. Part of the mast of the Northwest Passage ship. 4. Chronometer-box, with its number, name of the maker, and the Queen's broad arrow engraved upon it. 5. Two long heavy sheets of copper, three and four inches wide, with countersunk holes for screw-nails. On these sheets, as well as on most everything else that came from the Northwest Passage ship, are numerous stamps of the Queen's broad arrow. 6. Mahogany writing-desk, elaborately finished and bound in brass. 7. Many pieces of silver-plate, forks, and spoons, bearing crests and initials of the owners. 8. Parts of watches. 9. Knives and very many other things which you, Mr. Grinnell, and others interested in the fate of the Franklin Expedition will take a sad interest in inspecting on their arrival in the States. One entire skeleton I have brought to the United States.[1]

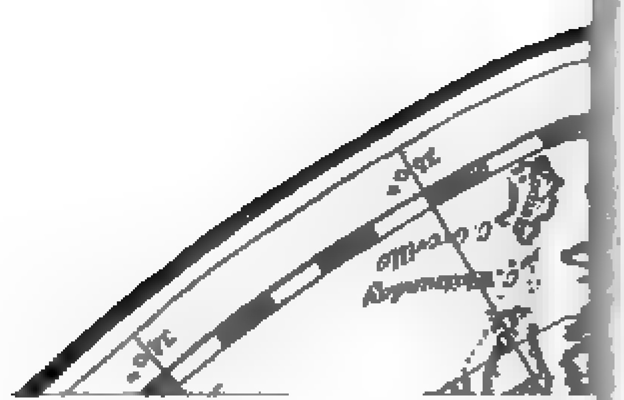
"*The same year that the Erebus and Terror were abandoned one of them consummated the Great Northwest Passage, having five*

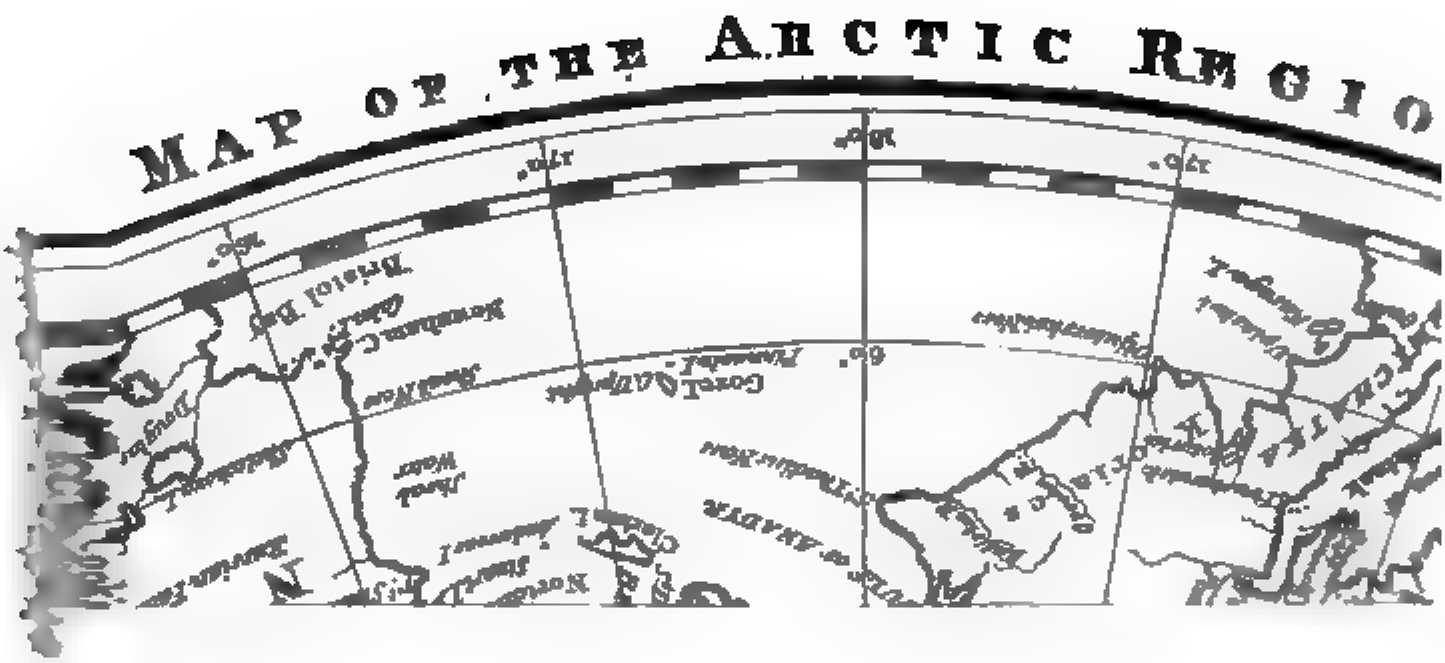
[1] After much hesitancy as though he might have done wrong in this, some time after his return, Hall placed the carefully-preserved remains in the charge of Mr. Brevoort, of Brooklyn, who transferred them to Admiral Inglefield, R. N., to be forwarded to England. Subsequently (by the plug of a tooth) the skeleton was identified as the remains of Lieutenant Vesconte, of the *Erebus*. (See Geographical Magazine, London, for April, 1878.)

men aboard. The evidence of the exact number is circumstantial. Everything about this Northwest Passage ship was in complete order. It was found by the Ook-joo-lik natives near O'Reilly Island, lat. 68° 30′ N., long. 99° W., early in the spring of 1849, frozen in the midst of a floe of only one winter's formation."

This vessel was sunk by the Innuits in getting wood out. The other vessel is reported by the Esquimaux to have been crushed by heavy ice in the spring of 1848, while the crew were engaged in getting out provisions. Capt. Crozier and another man, perhaps Surgeon Macdonald, appears to have survived their comrades and are reported to have been heard of by the natives near Chesterfield Inlet. There are some indications that a portion at least of the party after trying to go down the west side of King William's Land had turned back, doubled Cape Felix, and had passed down the eastern coast. Between Port Parry and Cape Sabine on that coast See-pung-er, an Innuit, reports finding a monument within which he found a tin cup containing manuscript which was thrown away as useless. " He said further that he and his uncle had spent one night near this monument, wrapping themselves up in blankets taken from a pile of white men's clothing found there, and that a kob-lu-na's (white man's) skeleton lay by the pile." " Hall appears to have been impressed with the great probability that all of Franklin's party had not continued on the hopeless route to Back's river." Prof. Nourse quotes Dr. Rae in confirmation of this opinion. This well-known Arctic explorer suggests that Fury beach where an immense stock of provisions still remained at the place where the *Fury* was wrecked was much more accessible than any of the Hudson's Bay Company's settlements.

But it seems very questionable whether the result would have been any the less disastrous had this course been adopted, feasible as it appears, for the rapidity with which the greater portion of the party succumbed to the hardships of the journey indicates great feebleness of health or great scarcity of food. That the latter was indeed the case we have every reason to believe, yet, why it should have been, with one vessel still afloat and afterwards found by the natives in complete order, and well supplied with all kinds of food (see page 404) is one of the many unsolved enigmas connected with the fate of the Franklin expedition. Capt. Hall thought he could account for as many as seventy-nine of the party, but for this belief he has to rely upon the very vague statement of the Innuits.




MAP OF THE ARCTIC REGIO
Bristol Bay
Gore I.

That a large number of books and manuscripts still remain buried in the snow on King William's Land and also records more carefully deposited may exist is at least highly probable, and it is very much to be hoped that the expedition now out under Lieut. Schwatka[1] has been able, as he hoped, to explore this island during the past summer. The monument and cache near Cape Crozier, however interesting and remarkable, are certainly of much less importance, and we are glad to learn that the time will not be lost in visiting them as first proposed. Although the accounts of the presence of white men in the north-western portion of the Melville peninsula are not to be overlooked, corroborated as they are by the existence of this monument and tenting place, it seems hardily possible that any members of the lost expedition should have gone in this direction; so far out of the way of help and necessitating the crossing of the Boothia gulf—more especially when the existence of the supplies at Fury beach must have been known by them.

Although geographical inquiry was not the first object of Hall's journey, he made many interesting discoveries which are clearly shown on his maps, several of which accompanying the text are of much interest and value. There are also eight sketches of coast lines drawn by the Innuits. The preliminary chapter is illustrated by circumpolar and other maps showing the progress of discovery since 1818, Franklin's track, etc.[2] A large circumpolar pocket map with explorers names and very satisfactorily mounted in sections is also given. It is brought down to the present time, showing the results of Nordenskiöld's discoveries and corrections of the Asiatic coast. The wood engravings are numerous and many of great interest. The appendix contains Hall's Astronomical and Meteorological observations, his conversations with the Innuits, and also a valuable paper by B. K. Emerson, Professor of Geology, at Amherst College, on the Geology of Frobisher bay and Field bay, as illustrated by the collections made by Capt. Hall in 1860–2 and now in the College Museum. Prof. Emerson states that " the common crystalline rocks of the Arctic regions, granitic and gneissose, made up the bulk of the collection." " With these were traps, red massive quartzites, sandstones, gray

[1] See NATURALIST, August, 1878, p. 571, and November, 1879, p. 723.

[2] A copy of the circumpolar map showing the progress of discovery is given herewith, for which and also for the accompanying illustrations we are indebted to the kindness of Prof. J. E. Nourse.

and cream-colored dolomites and limestones, and a few pieces of black cherty and dark fissile limestones, which furnished so many fossils new in these regions, and coming from a horizon which had not before been known to be represented so far north—that of the Utica slate." * * * "The geological collections made by

Aurora sketched by Hall.

him [Hall] give us the only information concerning the occurrence of the Lower Silurian in the whole of Arctic America, north of Rupert's Land, with the single exception of the fossils collected by Capt. McClintock and described by Houghton." These latter were brought from North Devon, Bellots straits and

King William's Land and a comparison with the fossils from Frobisher's bay, shows that that locality bears "somewhat the same relation to those of King William's Land and North Devon, which the typical localities of the Utica slate and the Hudson River group in New York bear to the more western areas of the Mississippi Basin." "In Frobisher bay we have a group of fossils unmixed with those of earlier or later date, which mark the exact horizon of the Utica slate, and the rocks have a lithological facies recalling that of the typical localities of this epoch in New York." "In the north-western area the whole Paleozoic series seem to be represented by a nearly unbroken succession of limestones, and the subdivisions merge into each other as in the central basin of the United States." "So that Houghton says, 'the whole of North Somerset, Boothia Felix, King William's Land and Prince of Wales Land is thus proved to be of Silurian age, although the evidence as to whether it is Upper or Lower Silurian is contradictory, as characteristic fossils of both epochs are found throughout the whole area.'" And the fossils from the Bay of Frobisher show that this great Arctic limestone area extends greatly to the south-east, and make it comparable in size with the central basin of the United States.

An interesting "note" by Hall on the finding of stones, rocks, and sands on the floe ice is given. He believes that these are caught up by the ice from the bottom of shallow waters and not deposited upon its surface.

"As the spring-tides come on, during their ebb, in many shallow parts of Hudson's bay, sheets of ice rest upon rocks, stones, shells, and weeds. These sheets of ice as they lie, send down showers upon the already moist bottom, all of which conglaciate at once into a solid mass by the piercing, pinching cold of the north. Rocks and stones, shells and weed, sheets of ice, and what was trickling water become *one* solid body. The tide now floods and lifts the floe, having on its nether surface a ponderous load of earthy matter. Before another ebb, King Cold has succeeded in adding several inches of ice underneath the structure of rocks, stones, land, shells, and weeds, which are now completely enveloped in crystal. Ebb and flood succeed each other, and as often add a stone or other foreign matter, and then another stratum of ice to the floe or smaller pieces of ice that during certain intervals are afloat or aground."

A paper on "Whale and Seal Oil in the manufacture of Jute," concludes a work which is a very valuable addition to the numerous narratives of Arctic discovery. *Ellis Hornor Yarnall.*

SKETCH OF NORTH AMERICAN ANTHROPOLOGY IN 1879.

BY OTIS T. MASON.

ANTHROPOLOGY is that science which has for its object-matter the human race, and has reference: 1. To the origin of man considered zoölogically, geologically, geographically and chronologically, and to his pristine mental and social condition, 2. To humanity as a whole compared with other similar groups of the animal kingdom, and with itself in different environments, and in various stages of culture; 3. To the natural division of the species into races or varieties.

This science is related, more or less intimately, with every other department of human knowledge; so much so that he who would know a great deal about this one subject, must needs know a little about everything.

Between anthropology and many ancillary sciences it is not very difficult to draw the line, if we keep in view the fact that it is always comparative, or gathering materials for comparison. The physician studies the structure and functions of the human body, not to compare but to heal. The historian regards the actions of men, so does the anthropologist; but the former pays most attention to the conduct of individuals, or the voluntary and incidental conduct of masses; while the latter scrutinizes those actions that are tribal, inherited; not so much what a people did, as what they did habitually; not so much what they are doing, as what they are accustomed to do.

As the bounds of knowledge widen and the relations existing between the soul of man and his material environment become better understood, many of those phenomena which are looked upon by the historian and the biologist as erratic, will be found working in obedience to physical and spiritual laws.

With this preliminary thought in our minds to guide and restrain us, let us take a glance at the field of anthropological research in our own continent during the year 1879. It will be necessary to include in this review works on American anthropology by foreigners as well as by our own scholars, and also those by American writers upon the subject in general, as well as upon topics outside of North America.[1]

[1] The writer must be pardoned if he does not sufficiently appreciate the merits of many worthy publications, and if he passes others by entirely No work that has

Anthropogeny.—As before indicated, the origin of man combines many subsidiary questions. Is he, or is he not, derived by descent from some ancestral species whose very remains as yet are hiding from us in tertiary strata? In what geological epoch must we search for his earliest occurrence? or, to what horizon do the earliest traces of him already discovered belong? At what precise spot on the earth did our race originate, granting that there was but one such locality? If there were more than one, the problem becomes the more complex indeed, but that does not relieve us of the responsibility of attempting its solution. How many centuries, or millenniums, or eons ago was this most interesting event? What was the bodily form and proportion, and what was the mental and moral status of that pristine individual or brood? The answers to all these questions may be divided into three classes, the brachychronic, the dolicochronic, and the agnostic, as the works bearing the following titles will show:

DELANEY, MARTIN R.—The origin of race and color. Harper & Bros.
COOK, JOSEPH.—Heredity, with preludes on current events. Houghton & Osgood, Boston.
DE QUATREFAGES, A.—The human species. Translated from the French and forming No. 27 of the International Scientific series. D. Appleton & Co.
FISKE, JOHN.—Darwinism and other essays. Macmillan.
HAECKEL, PROF. ERNST.—The evolution of Man. A popular exposition of the principal points of human ontogeny and phylogeny. Translated from the German. D. Appleton & Co. (By far the most learned treatise on anthropogeny published during the year. A summary of its contents, prepared by Lester F. Ward, of Washington, gives in small space a résumé of the work.)
KINSLEY, W. W.—When did the human race begin? *Penn Month.*, Sept., Oct.
MACLEAN, J. P.—Manual of the Antiquity of Man. Robert Clarke & Co., Cin.
MUDGE, B. F.—Another view of the antiquity of man. *Kansas Cy. Rev.*, Aug.
WARD, LESTER F.—Haeckel's genesis of man. E. Stern & Co., Philad.
WILSON, DANIEL.—Some American illustrations of the evolution of new varieties of man. *J. Anthrop. Inst.*, May.
The ethnical influence of physical geography. Am. Assoc. at Saratoga.

Archæology.—The province of archæology joins hard upon that of anthropogeny, if it does not overlap it in places. The latter, however, is concerned with the pristine or original facts of humanity, while the former regards the priscan condition of the various human groups. However long ago man is claimed to

been received by him is slighted. It may be well to remark that the Annual Record, hitherto published by the Harpers, will be continued in Prof. Baird's Smithsonian Annual Report, and authors desiring to be entered in the list of contributors to anthropological science must send a copy of their productions to me direct.

have lived in North America, none of the relics thus far discovered are supposed to belong to the origin of the race. It is a fact, however, that a far greater antiquity is demanded for our race than was supposed to belong to it a few years ago. The following contributions were all made during 1879:

ABBOTT, C. C.—Pliocene man. *Kansas Cy. Rev.*, Nov.

BARBER, E. A.—Antiquity of the tobacco pipe in Europe. *Am. Antiquarian*, II, No. 1.

Examination of Indian graves in Chester county, Penna. *Am. Naturalist*, May.

Native American architecture. *Am. Antiquarian*, II, No. 1.

BINKLEY, S. H.—Prehistoric manufacturing village in the Miami valley. *Am. Antiquarian*, I, 4.

BROADHEAD, G. C.—The walled lakes of Iowa. *Kansas Cy. Rev.*, Feb.

CLARKE, H. B.—Shell beds of Clatsop beach. *Am. Antiquarian*, I, No. 4.

Colorado, Ancient remains in. *Builder*, July 26.

CONANT, A. J.—Footprints of vanished races. C. R. Barns, St. Louis.

DE HART, J. N.—The emblematic mounds of Wisconsin. *Am. Antiquarian*, I, No. 4.

ELLIOTT, E. T.—The age of cave-dwellers in America. *Pop. Sc. Month.*, Aug.

FARQUHARSON, R. J.—The Rockford and Davenport tablets. *Am. Antiquarian*, Jan.

FORCE, M. F.—Some early notices of the Indians of Ohio. R. Clarke & Co., Cin.

FREY, L. S.—Were they Mound-builders? *Am. Naturalist*, Oct.

HALDEMAN, S. S.—On unsymmetrical arrow-heads and allied forms. *Am. Naturalist*, May.

HARTT, CH. FRED.—Notes on the manufactory of pottery among savage races. *Am. Naturalist*, Feb.

HOFFMAN, W. J.—Turtle-back celts in the District of Columbia. *Am. Naturalist*, Feb.

HOLMES, WM. H.—Notes on an extensive deposit of obsidian in the Yellowstone National Park. *Am. Naturalist*, April.

Report on the ancient ruins of Southwestern Colorado examined during the summers of 1875 and 1876. *Hayden's Annual Report for* 1876. (This valuable paper did not appear until 1879.)

JACKSON, Rev. S.—The ancient cities of Cibola. *Rocky Mt. News*, Jan.

JEWITT, L.—Pottery in prehistoric times. *Ill. Art Journal*, Nov.

Kansas, Prehistoric mounds in. *Kansas Cy. Rev.*, Jan.

LOW, C. A.—Appendix to Short's North Americans of Antiquity.

LYKINS, W. H. R.—Stone-age in Kansas. *Kansas Cy. Rev.*, Oct.

MACLEAN, J. P.—The Mound-builders. R. Clarke & Co., Cin.

MASON, G. C.—The old stone mill at Newport. *Mag. Am. Hist.*, Sept.

Mastodon, The home of the. *Kansas Cy. Rev.*, Sept.

MORSE, E. S.—Traces of early man in Japan. D. Appleton. (We mention this work not only because the author is an American, but because the remains which he has discovered are so wonderfully similar to those of the same class in our own country.)

PEET, S. D.—A comparison between the archæology of Europe and America. *Am. Antiquarian*, I, No. 4.
The sources of information as to the prehistoric condition of America. *Am. Antiquarian*, II, No. 1.
PERKINS, GEO. H.—Archæology of the Champlain valley. *Am. Naturalist*, Dec.
PUTNAM, F. W.— Archæological explorations in Tennessee. *Kansas Cy. Rev.*, May–Aug.
On some large and remarkable stone implements of the Southern Mound-builders. *Am. Assoc. at Saratoga.*
On the pottery of the Southern Mound builders. *Am. Assoc. at Saratoga.*
RAU, CHARLES — The Palenque tablet in the United States National Museum. *Smithson. Cont. to Knowledge*, 331.
The Dighton rock inscription. *Mag. Am. Hist.*, April.
READ, M. C.—The inscribed stone of Grave Creek mound. *Am. Antiquarian*, II, No. 1.
Stone tubes, used in smoking tobacco. *Am. Antiquarian*, II, No. 1.
REDDING, B. B.—How our ancestors in the stone-age made their implements. *Am. Naturalist*, Nov.
REYNOLDS, ELMER R.—Aboriginal soapstone quarries in the District of Columbia. *Rep. Peabody Museum*, XII. Abstract.
SHIPP, B.—Ancient artificial mounds. *Louisville Mag.*, Jan.
SHORT, JOHN T.—The North Americans of Antiquity. Harper & Bros.
SKERTCHLY, S. B. J.—Cliff-dwellers in the far west. *Century*, July 26.
SLAFTER, REV. E. F.—Prehistoric copper implements. *N. E. Hist. and Gen. Register*, Jan.
SOUTHALL, J. C.—The lapse of time since the Glacial epoch. *J. Vic. Inst.* Brochure.
TEMPLIN, L. J.—Antiquity of man. *Kansas City Rev.*, June.
VOGELES, A. W.—Notes on a lost race of America. *Am. Naturalist*, Jan.
WADDELL, J. A.—The failures and fallacies of prehistoric archæology. *So. Presbyterian Rev.*, Oct.
WOOLLEY, CHAS. F.—Sand-fields and shell-heaps. *Am. Antiquarian*, I. 4.

In closing this section, the writer would enter a mild and friendly protest against the careless and ruthless manner in which our antiquities are being destroyed. Upon those wealthy gentlemen whose tastes have led them to make aboriginal relics a matter of merchandise must certainly rest the responsibility of having them procured by the most competent hands, and all the circumstances and surroundings of the find accurately recorded.

Somatology.—Whatever may be our opinion respecting the materiality of the mind, no one denies that man resembles all other living creatures in the method of his generation, in embryonic development, in the periods of growth, maturity, and decay, in amenability to his material environment, in disease and heredity, and, briefly, in all those structural and functional characteristics which go to make up his animal nature. It is also true

that groups of men possess anatomical and physiological peculiarities which distinguish them as races or varieties, which seem to link them with animal groups not far below them, and which indicate an increase in refinement of organism coincident with the progress of civilization. A better knowledge of somatic characteristics has also enabled the anthropologists to call upon the witness stand other portions of the organism than the cranium. That American works in this field fall far behind those of Europe upon the same subject, any one may convince himself who will compare the following list with a fuller one in Baird's forthcoming Annual Report for 1879:

BURNETT, SWAN M.—A systematic method for the education of the color sense in children. Central Dispensary, Washington, D. C.

HOFFMAN, W. J.—The Chaco cranium. Government printing office, Washington.

The practice of medicine and surgery by the aboriginal races of the Southwest. *Philadelphia Reporter*, Feb. 22.

LATHROP, W. H.—Consanguineous marriages. *Boston Med. and Surg. J.* p. 837.

LECONTE, J.—Scientific relation of sociology to biology. *Pop. Sci. Month.*, Jan. and Feb.

PARKER, A. J.—Simian characters in negro brains. Proc. Acad. Nat. Sc. Philad. p. 339.

PATRICK, JOHN J. R.—Dental fallacies. Rumbold. St. Louis.

WRIGHT, J. S.—Some measurements of the heads of males and females. *Arch. of Med.*, N. Y., II, 113.

Comparative Psychology.—Upon this more recent field of anthropological investigation, few of our American scholars have entered. Among my notes I find only the following two references:

PSYCHOLOGICAL SCIENCE.—American anthropology. *St. Louis Eclec. Med. Jo.* April.

WILKINSON, W.—Is conscience primitive? *Pop. Sc. Month.*, March.

Ethnography.—The words ethnography and ethnology have gone the rounds of the anthropological vocabulary. It is not designed here to limit their application any more than to apply ethnography to descriptive works upon extant races, leaving ethnology to cover the whole subject of the anthropology of races included in our third division. The following works relate to North American races or were written by Americans:

American Indians, Notes and queries on the. *Missionary Rev.*, Sept.

BALDWIN, C. C.—Early Indian migrations in Ohio. *Am. Antiquarian*, I, No. 4.

BICKMORE, ALBERT S.—The ethnology of the Islands of the Indian and Pacific Oceans. Ill. Am. Assoc. at Saratoga.

CAMPBELL, JOHN—On the origin of some American tribes. *Canadian Naturalist*, IX, No. 4.

CLINT, WM.—The Aborigines of Canada under the British Crown. *Trans. Lit. and Hist. Soc.*, Quebec.

COFFINBURY, W. L.—An exhibition of Indian character. *Am. Antiquarian*, I, No. 4.

DAWSON, GEORGE M.—The past and present condition of the Indians of Canada. *Canadian Naturalist*, IX, 3.

FORCE, M. F.—Some early notices of the Indians of Ohio. Clarke. Cin.

Iroquois and Delaware Indians, Notes on the. *Penna. Mag. of Hist.*, VIII.

LECHEVALLIER, A.—Les Indiens Seminoles. *Naturaliste Canadien*, Aug.

MEEKER, N. C.—The Utes of Colorado. *Am. Antiquarian*, I, No. 4.

Natchez and Yuchi, Notes on the. *Am. Antiquarian*, II, No. 1.

PARKMAN, F.—La Salle and the discovery of the Great West. Little and Brown, Boston.

Although no volume has yet been published, Major Powell succeeded, upon the breaking up of his survey, in getting an appropriation for founding a Bureau of Ethnology, under the auspices of the Smithsonian Institution. A corps of the most competent workers are now engaged in making an exhaustive study of North American Ethnography.

Comparative Philology.—It is now the fashion to place language among the physical sciences. The students of this department of anthropology are a class by themselves, however, and we find it convenient to give the references to philological publications separately.

ADAM, L.—Du parler des hommes et du parler des femmes dans la langue caraibe. *Rev. Linguistique*, July.

BELL, ALEX. GRAHAM.—Vowel Theories. *Am. J. of Otology*, July.

BLAKE, C. J.—The logographic value of consonant sounds in relation to their transmission by the telephone. *Am. J. of Otology*, July.

BRÜHL, G.—On the etymology of the word *chichimecatl*. *Am. Antiquarian*, II, 1.

FARQUHARSON, J. A.—The phonetic elements in American languages. *Am. Antiquarian*, Jan.

FISK, JOHN—Review of linguistic and sociological works. *No. Am. Rev.*, Aug.

GATSCHET, A. S.—La famille linguistique Maskoki, et son dialect Hitchiti. *Congr. d. Américanistes.* 3d Sess.

Localbenennungen aus dem Berner-Oberlande und dem Oberwallis. *Arch. d. histor. Ver. d. Kantons Bern.* 1879.

Volk und Sprache der Máklaks in südwestlichen Oregon. *Globus*, Braunschweig. Nos. 11, 12.

Farberbenennungen in nordamerikanischen Sprachen. *Ztschr. f. Ethnologie*, Berlin, pp. 293–302.

Adjectives of color in seven Indian languages. *Am. Naturalist*, pp. 475–485.

On syllabic reduplication as observed in Indian languages, and in the Klamath language of South-western Oregon in particular. Proc. 111th Session Am. Phil. Soc., 35–37.

Mythologic text in the Klamath language of southern Oregon. *Am. Antiquarian*, I, 161–166.

Perez's Maya-Spanish Dictionary, reviewed in the *Am. Antiquarian*, II, 30–32.

HENRY, V.—Esquisse d'une grammaire raisonnée de la langue aleoute. Paris, Maisonneuve. *Rev. Linguistique*, Jan.

MALLERY, GARRICK.—The Sign-language of the North American Indians. Am. Assoc., Saratoga.

PEREZ, DON JUAN PIO—Diccionario de la Lengua Maya.

SIBLEY, DR.—Caddoquis, or Caddo Language. *Am. Naturalist*, Dec.

WILLISTON, S. W.—Indian pictographs in Western Kansas. *K's City Rev.*, May.

Arts and Industries.—Regarding the human race as a whole, for the time being, there are certain occupations of daily life, as well as means of gratification, which have had a history similar to that of an individual or of the race itself. We may ignore, if we please, the question of time and race, and follow the unfolding of this industry or pastime through all the stages of its growth. It is this study of comparative industry in all times and lands which lends such a charm to the writings of Mr. E. B. Tylor. In the whole range of anthropological study there is no question more puzzling than that which arises respecting the occurrence of the same art or industry in widely separated areas. On this subject I have collected the following titles:

Curious discoveries in regard to the manner of making flint implements by the aborigines and prehistoric inhabitants of America. (*Scientific American*). *Engineering and Mining Journal*, Aug. 9.

EELLS, M.—Indian Music. *Am. Antiquarian*, I, 4.

HOWLAND, H. R.—Primitive arts and modes of life. Buff. Soc. Nat. Sc. Mar. 15. Brochure.

TYLOR, E. B.

Sociology.—Under the head of Sociology are included the works of such authors as Morgan and Wilson in our own country, and abroad such names as Lubbock, Tylor, McLennan, Wake, Sir Henry Maine, and towering above all, Herbert Spencer. There is no civilized country where so many distinct races of men enter into one social compact as in our own. In addition to the conglomeration of Europeans, we have the African, the Mongolian, and the Aborigines, becoming hybridized in myriad combinations. To reduce this chaos to order and to learn the social lessons which it teaches is a work worthy of our ablest minds. During the past year the following publications have appeared:

AINSLEE, J. G.—Marriage customs. *Potter's Am. Monthly*, Sept., Oct.

B. E.—The Indian as a coming citizen. *Lippincott's Mag.*, Jan.

Burial Customs. *Am. Antiquarian*, Sept.

FARRER, J. A.—Primitive manners and customs. Henry Holt.

HOFFMAN, W. J.—Curious aboriginal customs. *Am. Naturalist*, Jan.
MUDGE, B. F.—Are the Indians decreasing? If so, why? *K's City Rev.*
REMBAUGH, Dr. A. C.—Our present race deterioration. *Penn Month.*, Ap.
Williams, A. M.—A grand council at Okmulgee. *Lippincott's Mag.*, Sept.

Religion.—There is no branch of anthropology where the "personal equation" is more complex and potent than in the treatment of religion. At the American Association Major Powell took as his theme, Savage Philosophy, adopting the views of Peschel that "In all stages of civilization, and among all races of mankind, religious emotions are always aroused by the same inward impulse, the necessity of discerning a cause or an author for every phenomenon or event." In addition to this view, which may be termed "comparative theology," there is comparative cult, including the organization of the people into clergy and laity, the places of worship with all their paraphernalia, the ritual, and religious observances. Now in the study of these phenomena each investigator is influenced by a theological or an anti-theological bias, which vitiates his testimony and deductions to a certain extent. Comparing our own country with the cultured nations of Europe, however, I think we may justly feel proud that so little bitterness and vituperation accompanies the discussion of this vexed theme: I give a few titles of publications which have come under my notice:

EELLS, M.—The religion of the Clallam and Twana Indians. *Am. Antiquarian*, II, I.
FARRER, J. A.—Fairy Lore of Savages. *Pop. Sc. Month.*, Sup., Feb.
GATSCHET, A. S.—Mythologic text in the Klamath language. *Am. Antiquarian*, Jan.
HENDERSON, J. G.—Superstitions relative to the owl. Am. Assoc., Saratoga.
Superstitions relative to thunder. Am. Assoc., Saratoga.
PEET, STEPHEN D.—Traces of Bible facts in the traditions of all nations. *Am. Antiquarian*, Jan.
POWELL, J. W.—Mythologic Philosophy. *Pop. Sc. Month.*, Nov., Dec. Am. Assoc., Saratoga. Vice-President's Address.
SPENCER, HERBERT—The Data of Ethics. D. Appleton & Co. [This work of the distinguished author is mentioned in our list because of the great number of reviews of it which have appeared both in religious and secular journals.]
THOMPSON, E. H.—Atlantis not a myth. *Pop. Sc. Month.*, Oct.

Instrumentalities of Research.—The question is frequently asked, Where can I look for information upon the results of anthropological research? The increasing number of intelligent persons interested in such topics makes it necessary to answer the question. On the whole, the best reply the writer can give is to

mention the sources from which he has derived his own information. And, firstly, there is no Society in our country which publishes a journal similar to the Journal of the Anthropological Institute of Great Britain and Ireland; Bulletins de la Société d'Anthropologie, de Paris; Revue d'Anthropologie, in the same city; Materiaux pour l'histoire de l'homme, Toulouse; Archiv für Anthropologie, Braunschweig; Zeitschrift für Ethnologie, Berlin. Authors of works on this subject find a means of publication in the Smithsonian Institution, the Peabody Museum, Powell's Bureau of Ethnology, the Proceedings of Local Societies, the Government Surveys, and the scientific and literary periodicals. The *American Antiquarian*, published by the Rev. S. D. Peet, of Ohio, is a praiseworthy attempt to afford anthropologists a common ground upon which they may meet. Owing to this desultory manner of publication many valuable papers would be lost sight of if some index to them were not preserved. In the Index to Periodical Literature of the American Bookseller, the section of anthropology in Index Medicus, published in Washington, and the anthropological summary of the AMERICAN NATURALIST, nearly every contribution of importance finds mention by title at least. Mr. S. H. Scudder, of Boston, has published, at great pains, a list of all the learned societies of the world. Sabin and Son's Dictionary of books relating to America has reached Part LXVIII.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— In our February number we drew attention to the then recent action of a majority of the Philadelphia Academy in reference to the policy of its management. We have since received the last number of the Proceedings for 1879, covering the months of November and December; also those for 1880 for the month of January. The former includes two hundred and fourteen pages of scientific matter, and fifty-eight pages of reports, an excellent showing for the Proceedings as a medium of publication. An inspection of the sources of this matter, however, reveals the fact that only three pages of it are the product of resident members of the Academy, or of those who have a voter's share in its

conduct. Of the eighty-eight pages issued in 1880, only two pages are from resident students, and one of these is occupied by matter already published elsewhere, for which no credit is given. We have referred to this view of the Academy's work on previous occasions, not with a view of disparaging its usefulness, but for the purpose of enforcing our assertion that its present organization is not calculated to foster native talent nor develop original research at home. And this with unrivaled facilities within easy reach, both in the form of men and means. We have ascribed this failure to the unwillingness of the Academy (1) to create collections for study; and to create or give positions of any degree of permanency to either (2) experts or (3) students; three points, it is easily perceived, absolutely essential to the accomplishment of work. We now add some new evidence of the correctness of these statements.

We quote the following from a newspaper report of an address delivered by Dr. J. L. LeConte at the recent centennial dinner of the American Philosophical Society:

"If time permitted I would be glad to mention to you what I conceive to be the proper functions of scientific societies, and the claims they have upon popular sympathy and assistance. They are, in a strict sense, neither oral teachers nor custodians; but, to use the phraseology of Smithson, so happily interpreted and applied by our venerable (in its true sense) associate, Prof. Henry, 'institutions for the increase and diffusion of knowledge among men.' I could show by many examples how, by departing from this simple path of duty, the resources of societies have been crippled and their usefulness paralyzed by indulging in the fascinating luxuries of large museums and ornate architecture. The former should be under the protection of governmental assistance, or in the care of largely-endowed institutions of learning. Voluntary contributions and unpaid labor can never support a museum which is rapidly growing; nor do such collections fulfill their functions except as appendages of universities. They soon degenerate into imperfectly classified storehouses of curiosities, occasionally visited by students desiring to verify types which have been imperfectly described. Though an investigator can be assisted, I have rarely known one made by the influence of a large museum. The material is too vast for the use of a beginner. The true life of scientific societies resides in the zeal of the members, the completeness of the library and the facilities afforded for publication. The objects for study lie everywhere around us and in us; and, as Prof. Agassiz told me many years ago, the most familiar objects, and those most frequently scrutinized, will give the most important results."

We doubt whether the views above expressed will be satisfactory even to those members of the Academy who approve the present management; although if the Academy publish princi-

pally for other institutions, it would seem appropriate that its members should also make collections for other institutions. That the president does not object to this form of suicide, may be derived from the following,[1] which is said to be from his pen:

"If A and B choose to bestow their treasures in Boston or elsewhere, and C prefers that the National Museum at Washington shall have his, the common cause of scientific progress is not injured, nor is the Academy any better or worse on account of such disposition. The value of scientific discovery is not contingent upon the locality where it may be made, or on the style or title of the discoverer. Every man is free to dispose of his own property as he may judge to be satisfactory to himself."

We doubt whether any other city of the civilized world presents such noble examples of self-abnegation as is implied in the above extracts. How far their fellow-citizens will be willing to share these crowns of self-immolation remains to be seen. Although a few may be found to console themselves with the pious reflection that "our loss is their gain," we doubt whether a general hosanna will arise on a distribution of important collections to other localities, excepting from the recipients.

The first speaker is pointed in his assertion as to the fate of a museum supported by voluntary labor, etc.: "They soon degenerate into imperfectly classified storehouses, etc." Has not the *kind* of labor and supervision something to do with this "degeneration?" Under incompetent hands nothing else can be expected. Prof. Agassiz says the most important results may be derived from the study of objects "around us and in us." For the entomologist this statement has an especial truth, but Prof. Agassiz took good care to make a great collection in zoölogy, palæontology and geology from all parts of the world. The position that an academy of sciences should not have a museum if it can, is absurd. As well try to run a mill without grist, or printing without type. That Philadelphia is not able or willing to have a museum, devoted first to the interests of original research, and second, for exhibition to the public, is, to say the least, highly improbable. This, of course, does not include "ornate architecture," which is not part of a museum, and which Prof. Henry very justly condemned. The Academy has indeed expended money in architecture, while its vitals have been unsupplied with food.

In further confirmation of our statements regarding the unsuitable nature of appointments to positions, we refer to the report of the Proceedings of the Academy at the end of this number of the NATURALIST. We add to this the further fact that one of the most able of our rising naturalists has been relieved of the scholarship which was endowed by the late A. E. Jessup, and which paid a small salary, without the offer of an equivalent place.

[1] Philadelphia *Evening Bulletin*, Dec 30, 1879.

This is objectionable in view of the fact that a single unscientific person (of course an officer of the Academy) draws two of the three salaries available for special students, and spends his leisure in advancing his pecuniary interests in other directions. We have here another discrimination against the specialist, besides the many we have cited in previous articles.

Some insight into the etiology of this pathological condition may be derived from a perusal of the report of the president near the close of the volume of Proceedings for 1879, referred to at the opening of this article. The leading officer of the academy states that "original research was not the sole object of the society." "No part of the museum or library can be held in reserve for the exclusive use of any class of specialists." Here again we perceive a remarkable obliviousness to the fact that original research requires the "exclusive use" of material so long as the research may last. So long as this is not permitted, the "free access to the museum," of which the writer speaks, is a farce. And to the prevalence of this and of the views previously cited, is due the small amount of original work apparent in the publications of the institution.

—— In *Nature* for March 18, the editor, in a brief notice of Prof. J. J. Stevenson's preliminary Report of the geology of portions of Colorado and New Mexico, in Capt. Wheeler's Annual Report for 1879, makes the following pertinent remarks, which are in accord with the views of this journal: "While referring to American official geological publication, we would point out the absolute necessity of reference to previous explorers. We could pick out not a few otherwise excellent reports, which are disgraced by an utter obliviousness of the existence of any earlier writings on the areas described. Without warning or explanation new names are given to formations which had already been named and described. If the original names and descriptions are defective or inaccurate, let that be stated, but in common fairness to fellow-laborers, not to speak of duty to the reading public, let us know distinctly whether we are perusing an account of ground that has never been described before, or whether we are merely getting a new rendering of facts already familiar to us. When the history of geological exploration in Colorado comes to be written how many different and rival expeditions will have to be enumerated, and in how many cases will it be found that they have recognized each other's existence?"

—— We learn that Mr. Pierre Lorillard, of New York, is preparing to defray the expenses of an exploration of the ruins of Mexico and Central America. The newspapers state that the plan involves the transfer of the monuments, sculptures, etc., to Paris, to be exhibited in connection with some institution under the name of the Museé Lorillard. We hope that this may not be true. If Mr. Lorillard sustains the expense of the explora-

tion, he should require that the objects obtained shall be placed in some of the museums of New York or Washington The educational interests of our country require all the aid that collections and museums can give, and future generations will doubtless be increasingly awake to their importance, and will hold in high esteem those who create or sustain them.

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RECENT LITERATURE.

THE ANNUAL REPORT OF THE HAYDEN SURVEY FOR 1877[1]—This is another permanently valuable contribution to the geological literature of the Western United States. The unusually fine and numerous illustrations accompanying it, add much to its value. Part I, geology and palæontology, comprises over 600 pages, illustrated by seventy-six admirably executed maps and sections, and ten plates illustrating invertebrate fossils.

This part is chiefly made up of reports by the chiefs of divisions and districts, of which there are five. Dr. Endlich, in his Report on the Geology of the Sweetwater district, seems to have given special attention to the mineral resources and economic geology of that region, and it is illustrated by six admirably executed geological sections of the country traversed. Dr. White's Report on the Cretaceous fossils, illustrated by ten magnificent plates, needs no comment, as the author's well-known reputation is a sufficient guarantee of the quality of the work. Orestes St. John has had charge of the work of the Téton division, which seems to have been very thoroughly done, being illustrated by thirty-nine maps and sections of the region traversed by his party. The Green River division, in charge of Dr. A. C. Peale has done good work, care being taken to give proper credit to those who had previously worked in the same field; twenty-nine maps and sections, together with analytical and ordinary landscape views, illustrate Dr. Peale's Report on the Green River country.

Part II relates to the topographical work carried on by A. D. Wilson and Henry Gannett, topographers of the survey, by whom the work of triangulation seems to have been conducted with great care. Altogether, the volume before us is a good example of the high degree of skill attained by Dr. Hayden and his assistants, not only in carrying on their field work on a large scale, but also in presenting its results in graphic and readily available form for the use of the reading public.

RECENT BOOKS AND PAMPHLETS.—Palæontographica. Band XXVI, Heft 3. Beiträge zur Kentniss der fossilen Fische der Karpathen, Von Dragutin Kramber-

[1] *Eleventh Annual Report of the United States Geological and Geographical Survey of the Territories, embracing Idaho and Wyoming*, being a Report of Progress of the Exploration for the year 1877. By F. V. Hayden, United States Geologist 8vo, pp. 720, 86 maps, plates and sections. Washington, D C, 1879. Advance copy, issued April, 1880.)

ger, 4to, pp. 53–68. Heft 4. Die radiolarien Fauna der Tripoli von Grotte, Provinz Girgenti in Sicilien, von Emil Stöhr. 4to, pp. 70–124, pl. VII. Cassel. Theod. Fischer. 1880.

Étude sur le Discoglosse. Par Fernand Lataste. 8vo. pp. 71, pl. III. (Extr. des Actes de la Société Linnéenne de Bordeaux, t. XXXIII, 1879.) From the author.

On the Iron Ore of Bartlett, N. H. By J. H. Huntington. 8vo. pp. 288–292. (Extr. from Proc. Bost. Soc. Nat. Hist. XX. 1879.) From the author.

The Ethmoid Bone in Bats. By Harrison Allen, M.D. 8vo. pp. 2. (Extr. Bull. Mus. Comp. Zoology.) Feb. 1880. From the author.

On the Elongation and Plasticity of Pebbles in Conglomerates. By M. E. Wadsworth, Ph.D. 8vo. pp. 313–318. (Ext. Proc. Bost. Soc. Nat. Hist.) From the author.

The Young Scientist. Vol. I, No. 9. New York, Sept. 1878. From the publishers.

Annual Report of the Geological Survey of Wisconsin, for the year 1879. By T. C. Chamberlin, Chief Geologist. 8vo. pp. 72. Madison, Wis. 1880. From the author. With atlas in folio.

Proceedings of the Poughkeepsie Society of Natural Sciences. From Oct. 1st., 1878 to July 1st, 1879. 8vo. pp. 72. From the society.

Etude sur les Poissons et les Reptiles des Terrains Crétacés et Jurassiques superieurs de l'Yonne. Par M. H-E. Sauvage. 8vo. pp. 20–84, pl. VIII. (Ext. Bull. Soc. des Sc. hist. et nat. de l'Yonne 3 ser, t. I.) From the author.

Matériaux pour l'Histoire des Temps Quaternaires. Par Albert Gaudry. 2é Fascicule. De l'existence des Saïgas en France a l'epoque quaternaire. 4to, pp. 65–82, pls. IV. Paris, 1880. From the author.

Physics and Politics; an application of the principles of natural selection and heredity to political society. By Walter Bagehot. (No. 3 of Vol. I of Humboldt Library of Popular Science Literature.) J. Fitzgerald & Co., New York. 1880.

On the Fertilization of Yucca. By Thomas Meehan. 8vo. pp. 4. (Repr. No. Am. Entomologist.) From the author.

Proceedings of the Royal Geographical Society and Monthly Record of Geography. Nos. 2 and 3, Vol. II, 1880. From the society.

On a new Genus and Species of Harpacticida. By P. O. Christopher Aurivillius. 8vo. pp. 16, pls. III. (Ext. K. Svenska Vet. Akad. Handlingar. Bd. 5, No. 18.) Stockholm. 1879. From the author.

Statuts et Règlement de la Société Zoologique de France. Fondée a Paris en 1876. 8vo. pp. 14. Paris, 1877. From the society.

United States Entomological Commission. Bulletin No. 3. The Cotton Worm. Summary of its natural history, with an account of its enemies, and the best means of controlling it; being a report of progress of the work of the Commission. By Chas. V. Riley, M.A., Ph.D. 8vo. pp. 144, pl. I. Washington, Government Printing Office. 1880.

United States Entomological Commission. Bulletin No. 5. The Chinch-bug. Its history, characters, and habits, and the means of destroying it or counteracting its injuries. By Cyrus Thomas, Ph.D. Washington, 1879 (issued 1880). 8°, pp. 44.

Memoires de la Société Royale des Sciences de Liége. 8vo. Tomes VII et VIII 2é Série. Bruxelles. Decembre, 1878. From the society.

The Journal of the Franklin Institute. No. 650, Vol. CIX. 1880. From the institute.

Eine neue Gattung von Scincoiden, aus New-Caledonien. By W. Peters. (Verbal communication on *Sauroscincus*. Extr. from Sitzb. der Gesell. naturforschender Freunde zu Berlin. 16 Dec. 1879.) 8vo. pp. 149–159. From the author.

Über die Eintheilung de Cœcilien und insbesondere über die Gattung Rhinatrema und Gymnopis. By W. Peters. 8vo. pp. 624–943, pl. I. (Extr. from Monatsber. d. Königl. Akad. d. Wissenschaften zu Berlin, Nov. 1879.) From the author.

A new species of Ophrydium (*O. ada*). By Hermann C. Evarts, M.D. 8vo. pp. 7. (Repr. Am. Monthly Microscop. Journ. Vol. I, No. I.) From the author.

Über neue Amphibien des Königl. Zoologischen Museums (*Euprepes, Acontias, Typhlops, Zamenis, Spilotes, Œdipus.*) By W. Peters 8vo pp. 773–779, pl. I. (Extr. Monatsb. d. Königl. Akad. d Wissenschaften zu Berlin. Aug. 1879.) From the author.

Über die Amphisbænen und eine zu denselben gehörige neue Art. (Lepidosternon Wuchereri) By W. Peters. 8vo. pp. 273 277, pl. I. (Extr. Monatsb. de Königl. Akad. d. Wissenschaften zu Berlin, März, 1879 From the author

Über die von Hrn Dr. G. A Fischer in Ost afrika, von Mombas bis in das Pokömo-Land und das südliche Galla Land, unternommenen Reise eingesammelten Säugethiere. By W. Peters. 8vo. pp 829–832. (Extr. Monatsb d. Königl Akad d. Wiss. zu Berlin, Oct. 1879) From the author.

Embryogénie de l'Asteriscus verruculatus. Par le Dr. J Barrois 8vo pp. 8, pls. II (Extr. de Journ de l'Anat. et de Physiologie.) Paris From the author

Recherches sur le Developpement des Araignées. (Communication preliminaire.) Par le Dr. J. Barrois. 8vo. pp 529–547, pl. I. (Extr. de Journ. de l'Anat. et de Physiologie.) Paris. From the author.

Sur quelques espèces nouvelles au peu connues du terrain crétacé du Nord de la France. Par Charles Barrois. 8vo. pp. 449–457, pls. III. (Extr. des Ann. de la Soc. Geol. du Nord T. IV 1876) From the author.

Sur l'éntendue du Système tertiare inferieur dans les Ardennes et sur les argiles a Silex. Par Dr. Chas. Barrois. 8vo. pp. 340–376. (Extr. des Ann. de la Soc. Geol. du Nord. T. VI, 1879.) From the author

Le Marbre griotte des Pyrénées Par le Dr. Charles Barrois. 8vo pp. 270–300. (Extr. des Ann. de la Soc. Géol. du Nord. Tom. VI, 1879.) From the author.

Catalogue of the Pacific Coast Fungi. (Published under the direction of the California Academy of Sciences.) By H. W. Harkness, M.D., and Justin P. Moore, A.M. 8vo. pp. 46. From the author.

Prodrome des Plesiosauriens et des Élasmosauriens des Formations Jurassiques Supérieures de Boulogne-sur Mer. Par M. H E. Sauvage. 8vo. pp. 38, pls. II. (Extr. from Ann. des Sciences Naturelles 6e Série. T VIII.) From the author.

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GENERAL NOTES.

BOTANY.

Fertilization of Flowers by Humming-Birds.—Prof. Beale's note under the above title in the Naturalist for February induces me to send the following observations, made in Alabama in 1879, which may be of some interest. The ruby throat was often seen to get nectar from both sets of glands at the base of the involucre about cotton flowers; it was constantly seen at the flowers of the low *Œnothera sinuata;* very often about those of the May-pop (*Passiflora incarnata*), the white flowered buck-eye (*Æsculus parviflora*), the wild and cultivated morning-glories, the yellow day-lily, the white oleander, several sorts of Pelargonium, the lemon, fuchsia, larkspur, malvaviscus, zinnia, "sage-bush," and "osier willow." One night just about twilight one was seen at the flowers of the gourd; and I several times saw them about the flowers of *Lobelia cardinalis*, where they usually acted much like the one spoken of in the Naturalist for 1879, p. 431, though the flowers were by no means always visited regularly from the bottom of the raceme up. The flowers of *Erythrina herbacea* were often visited by these birds, and appear to be adapted to

fertilization by them, like the "palosabre" (*Erythrina*, sp.) described by Belt.[1] The malvaviscus mentioned above does not fruit in the North where I have seen it cultivated, and experiments made a few years ago on a plant in Brooklyn showed that, in that case at least, artificial crossing between different flowers on the same plant did not lead to the production of fruit. Whether this is always the case with the plant as cultivated in the North I do not know, but it fruits abundantly in Southern Alabama, where it is perfectly hardy; and yet I could not learn that there was a plant within several miles of the one on which my observations were made, so that the crossing effected by the birds was probably between flowers of one plant. This difference may be due to the difference in climate.

The species which have been mentioned are all that are recorded in my notes, though birds were seen to visit many others, and a planter laughingly said to me one day, "You'll have to note every conspicuous flower if you want a full list of those visited by humming birds," reminding me of what Delpino says in his Ulteriori Osservazioni, P. II, Fas. II, p. 336, "According to Gould, to number all of the flowers frequented by this species would be equivalent to repeating the name of half the plants of North America."—*William Trelease.*

CARNIVOROUS HABITS OF BEES.—Apropos of the asserted killing and eating, by hive bees, of moths captured by the bladder-flower, *Physianthus*, I would like to call the attention of readers of the NATURALIST to the following statement by Kirby and Spence in their Introduction to Entomology, Letter XX, p. 384 of the seventh edition: "Though the great mass of the food of bees is collected from flowers, they do not wholly confine themselves to a vegetable diet; for, besides the honeyed secretion of the Aphides, the possession of which they will sometimes dispute with the ants,[2] upon particular occasions they will eat the eggs of the queen. They are very fond also of the fluid that oozes from the cells of the pupæ, and will suck eagerly all that is fluid in their abdomen after they are destroyed by their rivals."[3]—*Wm. Trelease.*

FUNGI AS INSECT DESTROYERS.—Two very interesting observations, bearing on one of the methods taken by nature to prevent an over-production of insects injurious to vegetation, are recorded in the introductory portion to the Thirty-first Report of the New York State Museum of Natural History: One of these is in regard to the destruction, by a fungus, of the "seventeen-year locust," which, it will be remembered, made one of its septemdecennial visitations in 1877. This fungus, which Mr. Peck de-

[1] Naturalist in Nicaragua, p. 130.

[2] Abbe Boisier, quoted in Mill's on Bees, 24.

[3] Schirach, 45. Huber, 1, 479.

scribes as belonging to a genus and species new to science, and which he names *Massospora cycadina*, develops in the abdomen of the insect, and consists almost wholly of a mass of pale yellowish or clay colored spores, having the appearance to the naked eye of a lump of whitish clay. Though the insect is not killed at once by the parasite, it is manifestly incapacitated for propagation, and thence the fungus may be said to prevent, to some extent, the injury that would otherwise be inflicted upon trees by the deposition of the Cicada's eggs While in the Adirondack region, Mr. Peck noticed the fact that the larvæ of some unknown insect, existing in countless numbers, and feeding upon the leaves of the alder, were fast threatening the destruction of this plant. Looking beneath the bushes for the pupæ of the insect in order to obtain a clue to the latter's identity, he was surprised to find that the larvæ, in every instance, had been killed by a parasitic fungus before they had had time to undergo their transformation; and he believes that by this provision of nature the alders of the above-mentioned region have been saved from utter destruction, inasmuch as in another year they would have been completely defoliated by the larvæ had but half of those which he observed been allowed to come to maturity.—*Bulletin of the Torrey Botanical Club.*

TWINING PLANTS.—In the last number of THE AMERICAN NATURALIST I notice a short article in reference to "the direction of the twining of plants." I have given the subject some attention, and my observations show that the direction is sometimes variable. I know a large vine of *Celastrus scandens* that branches fifteen feet from the ground, one branch of which turns to the right, the other to the left, so that for over twenty feet they cross each other every four feet, and in two places are self-grafted together, each plant or branch bearing flower and fruit.—*J. C. Andras.*

THE GERM DISEASE THEORY.—A contribution to this subject has been made by Koch, who finds that certain species of Bacteria, the lowest forms of plant life, occur in certain forms of disease in certain species of animals, and that such animals inoculated with such Bacteria suffer from these diseases. Koch's method has been to inoculate mice or rabbits with decomposing animal matter, to notice what symptoms, if any, were the result of the operation, and to examine the tissues of the infected animal for the particular form of microphyte contained in the injected fluid. By injecting putrid blood or infusion of meat and thus artificially producing septicæmia in mice, the animals died in a few hours, but it was found that the Bacteria originally injected were still confined to the cellular tissue under the skin, and that they had not propagated themselves. It was also found that healthy animals inoculated with the blood of the dead animal were not injured by it. Here, then, the disease was evidently due not to living

plants, but to a soluble poison—septin or sepsin—existing with the Bacteria in the putrid fluid. But other symptoms set in in about one-third of the cases, and it was found that one-tenth of a drop of blood from any part of an infected animal was able to communicate the disease to another. Thus Koch carried the disease through seventeen successive animals, the second being infected from the first, and so on through the entire series. An examination of the blood of any of these mice revealed multitudes of minute Bacillus-like Bacteria, of definite size and form, and evidently the contagium of this particular form of traumatic septicæmia, a disease peculiar to house mice. Beside the characteristic Bacteria, occasionally a Micrococcus-form was observed, which multiplied with great rapidity, forming characteristic chains in the subcutaneous tissue; the septicæmia-Bacillus at the same time living and increasing in the blood. When injected into a mouse's ear these micrococci produced a perfectly distinctive disease, *i. e.*, necrosis of the tissues of the ear, which were penetrated through and through, and completely destroyed by the rapid multiplication of the micrococcus plants. This and experiments on rabbits and other mice showed that infection was produced by infinitesimal as well as by large doses; the Bacterium-forms for each disease seemed thoroughly characteristic, the plants differing in size, mode of occurrence, &c., the presence of these microphytes being an indispensable requisite in the development of these symptoms. On the other hand, Dr. T. R. Lewis claims that one of the chief arguments against the germ disease theory, is the fact that a septiferous fluid retains its virulence after being boiled, filtered, evaporated, or combined with acids in the form of salts, but it is argued that this is not opposed to the action of a specific poison produced by the microphytes by a process of fermentation in the decomposing fluid.

Botanical News.—We glean from the *Journal* of the Royal Microscopical Society for February, the following notes:—The germination of the maize-rust (*Ustilago maydis*), which occurs in moist air in from twenty-four to forty-eight hours, has been observed by A. Renner.——The vine mildew or false Oidium which makes its appearance from time to time in vineyards in the United States, has been detected in France on stocks imported from this country. This mildew is frequently confounded with the true Oidium, but is allied to the potato disease, being caused by a nearly allied fungus (*Peronospora viticola*).——A new form of Bacillus has been found in the liver of a badger.——The spores of a number of species of Bacterium, Vibrio, Spirochæte, and especially Leuconostoc have recently been discovered by Van Tieghem. ——While Chiene and Ewart have stated that neither bacteria nor their germs exist in the healthy organs of animals, Nencki and Giacosa have ascertained by very careful experiments that they do

occur in healthy animals.——The cause of the movements of bacteria has been studied by Van Tieghem; while the ultimate cause is the contractility of the protoplasm, he thinks it is immediately due to the prolongation in places of filiform structures, to which he gives the name of appendages. These, he thinks, he has demonstrated to be the cause rather than vibratile cilia protruding through the cell wall.——A series of mycological preparations for the microscope of great value in the study of minute fungi have been made for sale by Dr. Zimmermann, of Chemnitz, in Saxony, Prussia.——The prospectus is issued of a proposed *Botanisches Central-blatt*, edited by Dr. O. Uhlworm of Leipzig. It is to be a weekly publication, consisting of information, reports, and abstracts of all papers in the various branches of botanical science published in Europe or America, titles of new books, etc. (*A. W. B.*)——The advance of the British troops into Affghanistan last year has not been without some scientific results. General Robert's force was accompanied by a naturalist, Dr. Aitcheson, who made large collections of plants, principally in the Kurum valley. These have been sent home and examined at Kew, and point to the interesting fact that in this valley we have a meeting point and intermingling of three very distinct floras, those of Western Asia, of India, and of Thibet.—(*A. W. B.*)

ZOÖLOGY.[1]

NOTES ON CALIFORNIA FISHES.—*Salmonidæ.*—Among the Salmonidæ that have occurred in the markets of San Francisco during September and October, the hump-back salmon, so-called from the prominent hump upon the back in advance of the first dorsal fin, has been conspicuous.

The anadromous salmon of this coast, that is, the salmon which ascend rivers to deposit their spawn but go to the sea to feed, belong to a different group from the well-known salmon of Europe and of the Atlantic coast. This latter *(Salmo salar)* is more nearly related to our brook trouts than to our salmon.

On account of the very long hooked jaw possessed by some of our Pacific salmon, they were grouped by Dr. Suckley under the generic name of *Oncorhynchus*, and by this name they are still known to naturalists. The character mentioned is not, however, the one to be relied on to distinguish these salmon, since the hooked jaws are only fully developed in the male sex after the spawning season; the females and young having straight jaws. This may be at once seen by a glance at the young *quinnat* (the common Californian salmon) now in the market. As they lie beside the old males with their excessive development of teeth and jaws, they seem a different species. The most reliable, obvious character, is the number of the anal rays, which in our

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

Pacific coast salmon is seventeen, as in the European salmon and all trout.

Now there are five species of *Oncorhynchus* on this coast, and of these three are more or less hump-backed. All five are found in the Columbia, but they do not all inhabit Californian rivers. The common species, the *quinnat*, is not hump-backed. *Oncorhynchus nerka*, a somewhat hump-backed species with scales of about the same size as those of the *quinnat*, is on record from the rivers of California, but I have not yet detected its presence in our markets. This species grows as large as the common salmon, and is more cylindrical in form.

The hump-back now in the market is not this species. It has very small scales in more than two hundred transverse rows, is exceedingly compressed and thin in the body, has an excessively developed hump, and, so far as I have observed, does not reach the dimensions of the *quinnat*. These characters, taken together, prove that it is the species now known as *Oncorhynchus gorbuscha*.

I may here remark that the species of salmon and trout are probably more difficult to distinguish than those of any other tribe of fishes, partly because of the changes they undergo with age, and partly from seasonal and sexual changes. For example, the *quinnat* from the fresh water is light with round dark spots, from the sea it is of a bright steely blue. After the spawning season, as was previously observed, the lower jaw of the male acquires a more decided hook than usual. A careful examination of the teeth, of the gill-arches and of the pyloric appendages of the stomach has to be made in order to distinguish the species.

Early observers on this coast, relying on external characters, made the species much more numerous than they really are, founding their species on differences due to age, sex or season. Recently Profs. Gill and Jordan have reviewed the group, and the result is that the number of species is greatly reduced. *O. gorbuscha* includes the *gorbuscha* of Artedi, 1792, the *gibber* of Blon, 1801, and Suckley, 1861, and the *proteus* of Pallas, 1811. This is par excellence the hump-back salmon, does not attain a large size, and is on record as ranging from Washington to Kamtschatka. Its occurrence in our markets proves that in the autumn it visits the neighborhood of San Francisco. The dealers tell me it is taken in the Sacramento. *O. keta*, which is on record as ranging from Oregon to Kamtschatka, includes four nominal species described by various authors (*keta*, *lagocephalus*, *scouleri*, and *confluentus*), while under *O. nerka*, which is reported to range from California to Kamtschatka, are included no less than ten nominal species, five of them described by Dr. Suckley. It is curious that the commonest species has, except when young, always been known by its Indian name of *quinnat*.

Notwithstanding the diminution in the apparent number of the Pacific coast Salmonidæ (taking the word in the sense it was used

occur in healthy animals.——The cause of the mc bacteria has been studied by Van Tieghem; while t cause is the contractility of the protoplasm, he thinks diately due to the prolongation in places of filiform s which he gives the name of appendages. These, h has demonstrated to be the cause rather than vibrati truding through the cell wall.——A series of mycolo rations for the microscope of great value in the stud fungi have been made for sale by Dr. Zimmermann, o in Saxony, Prussia.——The prospectus is issued of *Botanisches Central-blatt*, edited by Dr. O. Uhlworm It is to be a weekly publication, consisting of informat and abstracts of all papers in the various branches science published in Europe or America, titles of new (*A. W. B.*)——The advance of the British troops int tan last year has not been without some scientific res ral Robert's force was accompanied by a naturalist, D who made large collections of plants, principally in valley. These have been sent home and examined point to the interesting fact that in this valley we h point and intermingling of three very distinct fl Western Asia, of India, and of Thibet.—(*A. W. B.*

ZOÖLOGY.[1]

NOTES ON CALIFORNIA FISHES.—*Salmonidæ.*— monidæ that have occurred in the markets o during September and October, the hump-back from the prominent hump upon the back in ad dorsal fin, has been conspicuous.

The anadromous salmon of this coast, th which ascend rivers to deposit their spawn b feed, belong to a different group from the w Europe and of the Atlantic coast. This latt more nearly related to our brook trouts than

On account of the very long hooked jaw our Pacific salmon, they were grouped by I generic name of *Oncorhynchus*, and by thi known to naturalists. The character ment the one to be relied on to distinguish t hooked jaws are only fully developed in spawning season; the females and youn This may be at once seen by a glance at common Californian salmon) now in th beside the old males with their excessi and jaws, they seem a different speci obvious character, is the number of th

[1] The departments of Ornithology and Mammalo Coues, U. S. A.

many owners of "brown stone fronts" have put up wire screens to keep them from nesting over the windows and doors, and many other buildings are rendered unsightly by their droppings. Houses are put up for these feathered Arabs, and in Newark, as in many other places, the fiction that the sparrow is an insectivorous bird is cherished, notwithstanding the fact that they can be seen seeking their food in the middle of the street, and that their short bills indicate a preference for grain.

Grace church is the best place in the city to study sparrows, its splendid ivy-covered sides being rendered unsightly by the straws and sticks which protrude from it all the way from ten feet from the ground to the eaves, in many places one to each square foot. The noise of this colony greatly interferes with the services, so much as to make it necessary, as I am informed, to close the windows in summer; and the walk in front, under the trees, is polluted by their droppings, and many dresses have thus been ruined.

Several nests were completed in the ivy on Grace church before the 10th of January, when a few days of cold and wet weather put a stop to further desire for housekeeping for a few days. It was renewed again from the 15th to the 20th, but just how far it had advanced by the time of the Christmas snowfall, I cannot say, as the nests are difficult of access; still the fact of their building would argue that if the weather had continued mild for a week or ten days longer a brood would have been the result.—*Fred. Mather.*

A New Preservative Fluid.—About six months ago the German papers brought to notice that the conservator of the University of Berlin, Mr. Wickersheimer, had invented a fluid for preserving animal as well as vegetable tissues, which was said to surpass anything that had ever been used for that purpose. Mr. Wickersheimer's laboratory was reported to be the gathering-place of all sorts of scientists, who were unanimous in commending the extraordinary beauty and elegance of the specimens which Mr. Wickersheimer showed them, a number of which had been preserved for a considerable space of time. The well-known naturalist, Carus Sterne, reported in No. 22 of the "Gartenlaube" as follows:

"Mr. Wickersheimer has two ways of operating with his fluid. He either injects it into the veins of the body which is to be preserved, or soaks the whole object or any part of it in the fluid. By these methods the bodies are preserved from decomposition, and after having been taken out of the fluid and dried, their natural colors as well as the elasticity of the tissue and flexibility of all the joints are secured.

"Reporter saw the body of a boy which had died several months before, lying free in the open air and having perfectly

preserved the appearance of a sleeping child. The body was of a natural softness and had preserved the appearance of life to a surprising degree.

"Mr. Wickersheimer showed a number of skeletons in which (the ligaments being preserved in their natural condition and elasticity) all the complicated movements could be executed and studied, of course much better than by aid of connecting wires and artificial joints. Some of the specimens showed beautifully the combined movements of the chest, the larynx and other parts in breathing. Several skeletons of snakes which had been treated with the fluid a year ago, allowed to show the spiral and undulatory movements of any part of the skeleton.

"But," the reporter continues, "not only the ligaments but also the vessels and membranes of animals will show the same indestructible softness and elasticity. The lungs thus prepared in connection with the wind-pipe may, even after years, be inflated by means of bellows. Such old lungs of several animals reporter saw swelling to ten times their size; the lobes became distinctly separate; the brown color gradually changed into red, and at length the whole body appeared as if taken from out of a fresh body.

"Also the digestive organs after having been cleaned, prepared and blown up, may be transformed into durable preparations which are undoubtedly far more instructive than any of those common imitations in papier-mâché.

"Further, the fluid offers great advantages for the preservation of such delicate objects which have to remain in a liquid medium. There is no discoloring, no shrinking of the objects as in alcohol (even when diluted). Sections of delicate tissues, morbid formations which have been removed by an operation, will appear after months as if in a fresh condition, and may thus be preserved for further study.

"Finally, all sorts of vegetable organisms, such as flowers, fruits, fungi, etc., will excellently preserve in this fluid and are sure to maintain their natural appearance for a long time Reporter saw a colony of those delicate common fresh-water algæ which had been in the fluid for a year and had so beautifully preserved their green color that they appeared to grow in the water in their natural condition."

Some time previous to this report, Mr. Wickersheimer had offered his invention to the Prussian government for a reasonable compensation. The government accepted the offer and appointed a committee of experts to examine the fluid and test its qualities and effects. The very satisfactory results of these examinations have been quite recently published by the State's-Secretary of the Department of Instruction in the official "Staatsanzeiger,"

together with the following formula for the preparation of the fluid:

In 3000 grammes of boiling water dissolve

Alum	100 grammes.
Common Salt..................................	25 "
Saltpetre....................................	12 "
Potash	60 "
Arsenious Acid...............................	10 "

After cooling and filtering, add to every ten litres of the solution, four litres of glycerine and one litre of methyl. alcohol.

The "Staatsanzeiger" says:

"The method of application differs according to the nature of the objects that are to be preserved. Anatomical preparations, whole bodies, etc., that are to be preserved dry, are laid (according to their size) from six to twelve days into the fluid, then taken out and dried in the open air. The ligaments, the muscles, etc., will now remain soft and flexible, so that at any time the natural movements can be executed.

"Hollow organs, such as the lungs, bowels, etc., must be filled with the preserving fluid, then laid in a vessel containing the same fluid and afterwards dried after the fluid has been poured out and the objects have been distended with air.

"Smaller animals, such as crabs, beetles, lizards, frogs, etc., if the natural colors are to be preserved unchanged, are not to be dried, but put up in the fluid.

"If human or animal bodies are to be preserved for a longer space of time before they are used for scientific purposes, it is sufficient to inject the fluid. Two litres, f. i., will suffice for a child of two years; about five litres are required for an adult. By this treatment the muscles will appear (even after years, when sections are made) as if in a fresh condition. If thus injected human bodies are preserved in the open air, they will gradually lose their fresh appearance and the epidermis will assume a brownish shade. But even this can be avoided if the fluid is externally rubbed into the skin, and if the access of air is prevented as far as possible.

"This latter treatment may be recommended for corpses that are to be exhibited to the public or are to be preserved for some time before they are buried, for the features will remain unchanged in their expression and color, and there will not any smell be perceptible.

"For the real embalming a method of combined injection and preservation in the fluid is to be applied. The bodies, after being injected, are kept in tight cases, being wrapped in clothes which have been saturated with the solution."—*W. Barbeck.*

THE SPOTTED SALAMANDER.—Every one who has collected water-plants or animals in the marsh-pools or quiet streams of

the Eastern United States is familiar with the spotted salamander, or water newt (*Diemyctylus viridescens* R.).

In their adult dress (olive-brown above, yellow beneath, and a row of vermilion spots along each side) they can be seen in numbers, from early April till the middle of June, in shallow pools, basking on the surface, or floating motionless with the slow current, or walking among the submerged plants It is the only salamander I know whose habits are so diurnal that it enjoys the sunshine. I have caught them by the dozen at noon on sunny days. In the spring they prefer open pools or streams of slow-moving water where there are no trees, but plenty of plants and tufts of grass. But later in the year, when the sun becomes torrid, when the streams of the marshes are shrunken, and temporary frog ponds are nothing but patches of dried and cracked mud, the adult spotted salamander is seldom seen. I suppose they are hidden among the roots and tufts of grass. At least my specimens in confinement always get in such places.

I have kept them in a box filled with earth, grass and moss, in which there was always a dish of water standing, but they did not care to stay long at a time in the water. Sometimes they would not remain in it for weeks, although they walked through it many times in crawling around; and they ate and were as lively as when caught.

In the breeding season, when they spend a greater part, if not all the time, in the water, their colors are brighter and the black markings are very distinct. The compressed tail has a fin-like extension of the integument above and below, which enables them to swim with ease. Afterwards the colors become dull and the fin is absorbed. In these particulars they resemble what is said of the *Triton* (?) *cristatus* of Europe.

The eggs, which I have seen, are glued singly in the axils of leaves, or the terminal whorl of finely-divided leaves, or folded up in grass blades. Often the leaves are stuck so close to the egg that the latter is not visible. Prof E D. Cope has noticed the eggs of *D. viridescens* "laid singly on leaves of Myriophyllum which adhere to the glutinous egg, concealing it." (Packard's Zoölogy, 1879, p. 479.) My observations differ from those of Prof Verrill and S. J. Smith (AMERICAN NATURALIST, Vol III, p. 158), who state that they found "rounded masses, like frogs eggs, on the stems of water plants." The larvæ, too, that were hatched from the eggs they found had "rather stout bodies and broad heads" All the larvæ I ever saw of *D. viridescens* have been slender, with narrow heads and pointed noses. They can be distinguished at all times from the stout broad-headed larvæ of *Amblystoma punctatum*. I have caught adult specimens in the breeding season, placed them among plants where there were no eggs They laid eggs in the axils of the plants, and the eggs hatched to larval spotted salamanders. In the manner of placing the eggs,

they agree with what Prof. Owen says of the *Triton cristatus* and *L. punctatus*. The eggs are about an eighth of an inch long, elliptical, with a tough envelope, and greenish fluid surrounds the yolk part. They are laid early in April or May, according to the season. The larvæ are very timid. I have kept them till they became terrestrial and had yellow spots along their olive-green sides, but they would not eat, and died in about a week. I am very sorry not to have been able to keep any till they reached the red eft stage. Their dying so young makes a break in the chain of observed facts that prove the red eft to be a young form of the spotted salamander.

The red eft (*D. miniatus* Raf.) was described as a different species on account of its color, which is orange-red with vermilion spots. Lorne still holds that it is a distinct species, or a variety. Dr. Hallowell first suggested that they were the same species (Proc. Acad. Nat. Sci., 1856), and Prof. Cope has maintained the same opinion (Proceed. Phila. Acad., 1859). Mr. H. A. Kelly kept some red efts till they became spotted salamanders (AMERICAN NATURALIST, Vol. XII, p. 399). I have also observed the change several times. All the red efts I have seen were small. I believe, but am not able to prove at present, that the young *D. viridescens* attains its red garb the summer it is hatched, remains that color about a year, then gradually becomes duller as it attains full size. I have found red efts in dead wood some distance from water, but never in the water; I found one November 1, after two severe frosts, under a loose stone near a marsh. I have kept *D. viridescens*, *A. punctatum* and *Desmognathus fusca* alive for more than a year at a time. The first two species became so tame that they would stretch up their heads, expecting to be fed, whenever they heard my voice. I have seen *D. viridescens* eat tadpoles. They never seem to be able to get enough of them. The salamander puts his nose close up to the tadpole and remains perfectly still. If the tadpole does not stir, his life is saved, for the salamander soon moves off; but if he wriggles the least bit he is down the throat of his enemy in an instant. In taking bits of meat from a wire, they slowly open the mouth, protrude the tongue, and gently pull it off. *A. punctatum* snaps off the meat with a quick jerk.

I have never seen any salamanders use the fore foot as a hand in adjusting food in the mouth, or for removing objectionable pieces, but I have very often seen my tree toads do so.

I have frequently seen the *D. viridescens* shed its skin. They are restless before shedding and refuse food, and are weak for some time after the skin is removed. After the skin is loosened, they press it from the head and front legs by rubbing against some projection in the box, presenting different sides during the operation. Sometimes they remove the whole skin in this manner. At other times, after the old skin was removed from the

arms, I have seen them push it from the rest of the body by alternately pressing against the sides with their hand-like front feet, in the same way that a person might strip off a tight garment. The skinning takes an hour or more, and after the integument is off they roll it up and swallow it.

If kept in a warm room salamanders take food regularly during the winter and seem as lively as in summer. Tree toads kept in the same room will not eat. On the approach of cold weather they dig their way under sods and remain buried and torpid till spring. This would indicate that hybernation is not as settled a habit with these two species of salamanders as with the tree toads.—*S. P. Monks.*

Growth as a Function of Cells.—Dr. Charles Sedgwick Minot has published an article in the Proceedings of the Boston Society of Natural History on "Growth as a Function of Cells." This essay is an attempt to give an exact analysis of the problem of growth. The author considers that growth depends upon an impulse created at the time when the *ovum* is impregnated; this impulse he terms rejuvenation, because the vital power is made young again in a new cycle of cells. The old cycle of cells passes away, the parent dies, but a new egg-cell is produced endowed with an extraordinary power of division, which causes the birth of successive generations of cells. Now usually the number of cells is doubled at every division, that being the least possible increase, hence the number of cells must increase in geometrical progression; therefore, the growth of every animal would be indefinite were there not an opposing influence. This opposing influence cannot be the loss of a part of the cells, as when part of the skin peels off, for this loss is too slight to counterbalance the multiplication. The explanation is, that the intervals between the births of two successive generations of cells continually increases, or in other words the frequency of the divisions continually diminishes. This Dr Minot calls the phenomenon of *senescence*, to which he attributes the utmost importance, as a vital phenomenon common to all animals, yet hitherto entirely unstudied. He says. "From our point of view this change (in the frequency of division) is the most important alteration produced by senescence; that it really occurs is not only a deduction, but is shown by actual observation, for no one can question that the division of the cells during segmentation of the yolk proceeds at shorter intervals than during adult life; thus in an egg say eight or ten, perhaps more, generations of cells may be born in the course of a single day, all the cells dividing; but we cannot for an instant imagine that all the cells of the human adult, for example, divide upon an average even once a day, probably * * * * not * * * * even once a year." But the size or weight of the whole animal depends not only

upon the number but also on the volume and weight of the cells. Dr. Minot therefore discusses the laws which govern the variations of the size of cells. The relations of growth to the size of animals is next considered, the conclusion being drawn that the rapidity of the senescence determines the size of the animal, because the more rapidly the frequency of the cell divisions diminishes, the sooner will growth cease and the smaller will the animal remain, so that in this respect senescence exercises a fundamental influence. This, is, we believe, the only scientific attempt to explain the reason why animals are of different sizes. Finally by a novel reasoning the conclusion is drawn, that although the animal grows in three dimensions, yet the growth of the cells is confined to two dimensions of space. For the detailed arguments supporting the author's conclusions, the original article must be consulted.

SCOLOPENDRELLA AS THE TYPE OF A NEW ORDER OF ARTICULATES (SYMPHYLA). — In examining a series of specimens of *Scolopendrella notacantha* Gerv., and a species which I believe to differ from *S. immaculata* Newp., and which I have called *S. gratiæ* (both forms collected in the Philadelphia park), I find characters which appear to warrant the creation of an ordinal division for their reception. The new group may be characterized in accordance with my observations as follows:

Head essentially insectiform, or, more specifically, like that of *Campodea*, with *mandibles, maxillæ and apparently a ligula*. The labrum and labium are well defined, and the former is separated from the *epicranial pieces by a well-marked suture*. Antennæ 14–28 articulate. Body with thirteen segments (exclusive of head), to which are appended not more than twelve pairs of *five-jointed legs, each terminated by a pair of claws, as in insects. At the bases of each pair of legs a pair of simple hairy appendages are attached, except to the first or postcephalic:* these are fully three times as large in *S. gratiæ* as in the other species. Caudal stylets in a single pair, tapering, unjointed.

Genital orifice on the ventral side of the body opening on the third or fourth body-segment in both sexes. In one sex the opening is a *simple pore*, in the other a *longitudinal cleft*, closed by means of an oblong chitinous piece on either side, the two together occupying a subquadrate space. Heart, dorsal; *tracheal system represented by a series of simple tubular arches, without a spiral filament, which arise from openings on the ventral surface of the animal, inside the bases of the legs, widening and passing upwards to end apparently in close relation with the dorsal vessel. Intestine straight*, with two very long, tortuous malpighian tubules opening into it at the posterior third (*S. notacantha*).

The genital glands, as well as the nervous system, I have not made out with any degree of certainty. The muscle

tinctly striated, and the blood corpuscles small. The intestine has the portion in front of the rectum dilated; this is especially notable in *S. gratiæ*, where this part of the alimentary canal is usually filled with the remains of undigested vegetable food. The distal, thin, laminar elements of the jaws and maxillæ are deeply toothed and much resemble those of *Campodea*, as figured by Meinert

This form, as interpreted above, becomes of the highest interest to the zoölogist, and if the writer is not mistaken, the biunguiculate legs and their nearly complete correspondence in number with the rudimentary abdominal and functional thoracic limbs of the *Thysanura*, especially *Machilis* and *Lepisma*, which also have basal appendages to the legs, indicate as much affinity with insects as with myriapods, and may indeed be looked upon, perhaps, as representing the last survival of the form from which insects may be supposed to have descended. I name the new group *Symphyla*, in reference to the singular combination of myriapodous, insectean and thysanurous characters which it presents.—*John A. Ryder.*

Note on a larval Lithobius-like Myriapod.—I recently met with a very small specimen of this type of myriapod with seven pairs of legs. The claws are simple, as in the adults, the same as I have observed in larval specimens of *Julus* and *Trichopetalum*, and in both adult and immature specimens of *Eurypauropus*. The mouth parts are a miniature of those of the adult. The specimen was nearly an eighth of an inch long.—*J. A. R.*

Trichopetalum.—I have found Harger's *T. lunatum* in great abundance in the Philadelphia park, which greatly extends the range of this Lysiopetalid myriapod.—*J. A. R.*

Dr Chapman on the Placenta of Elephas.—The birth of an elephant at full term (twenty months and twenty days, according to the records kept by the keepers at Dr. Chapman's request), in Cooper & Bailey's menagerie in this city, afforded a unique opportunity to study the mature placenta of these huge animals. The placenta proper was found to be *zonary*, and was believed to have encircled the fœtal elephant during gestation. The amnion and chorion formed two large oblong pouches, one within the other and were fused together equatorially at their narrowest diameters, the point where the placental villi were developed On either side of the placental zone of villi, the numerous cotyledons were developed. The placentation was found to be essentially non deciduate, and diffuse in character, with a zonary form, this combination of characters renders Dr. Chapman's observations of great interest and systematic importance. No naturalist of recent times has ever had so good an opportunity to study this structure; the specimen described by Professor Owen is sup-

posed, from its size, to have been immature, whilst the interpretations, figures, and descriptions of the parts by the older authors are necessarily unsatisfactory, owing to their lack of comparative knowledge.

ZOOLOGICAL NEWS.—A new class of marine silicious Rhizopods, called by Haeckel *Phæodaria*, rich in specific forms and remarkable in many respects, is described in *Nature* by this indefatigable observer. Over 2000 "species" have been collected by the *Challenger* expedition. The greater number of the species are visible to the naked eye——The development of *Amblystoma punctatum* is described by Dr. S. Clarke, with excellent figures, in the Studies from the biological laboratory of the Johns Hopkins University.——Considerable has been done by the Scandinavian naturalists concerning the singular Crustacean parasites of the sea worms, these Lernæan forms being attached to the bodies of the worms. A number of new forms of much interest have been described and elegantly figured by Levinsen in the Proceedings of the Natural History Society of Copenhagen.——Hewitson and Moore's Descriptions of New Indian Lepidopterous insects is to appear in parts. For the first part we are indebted to, Dr. Hayden. A number of forms are related to American species, hence this publication is of interest to lepidopterists in America.——The death of Dr. Boisduval, the well-known lepidopterist, who described so many North American butterflies and moths, is recorded. He attained the age of eighty-one years.

ANTHROPOLOGY.[1]

PEABODY MUSEUM AT CAMBRIDGE.—Prof. F. W. Putnam, in three communications to the Boston Society of Natural History, during October and December gave an account of the work of the Peabody Museum. The first had reference to chambered barrows, already mentioned. The second to ancient mounds and burial places in Cumberland Valley, Tennessee. Several thousand ancient stone graves have been opened. A walled town on the Lindsley estate, twelve acres in extent, enclosed by a bank and ditch was described. A mound in the area contained sixty human skeletons, each in a carefully made stone grave, the graves being arranged in two rows forming four sides of a square, and in three layers. About seventy ground plans of ancient houses were traced out. Under the floors of hard burnt clay were the graves of children, from one to four under each house. The third paper treated of the ornamentation of pottery. The author concludes from a wide induction that the seemingly useless appendages of more refined ceramic ware are survivals of useful parts in a ruder age, and that the study of the ornamentation of pottery will furnish an important clue to the progress of culture.

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

For about two years Mr. J. Francis Le Baron, Chief Engineer of the St. John's and Indian Rivers railroad at Titusville, Florida, has been engaged in making a reconnoissance of the archæological remains in Eastern Florida for the museum. During this period he has located on a copy of a government map of Florida, published by the War Department, no less than 173 stations, comprising shell-heaps, burial-mounds and fortifications, in a region extending about 300 miles south of the mouth of the St. John's, and inland along that river and over-land to Lake Okeechobee. The majority of the stations are, however, on the St. John's and Indian rivers. Taken in connection with Prof. Wyman's account of the shell-heaps of the St. John's river, the map and accompanying report by Mr. Le Baron forms a valuable addition to our knowledge of the position and number of the prehistoric sites in Florida. Mr. Le Baron has also in his report called attention to several groups of tumuli of special interest which should be explored in detail if funds can be obtained for the purpose, for they are of a different character from the ordinary shell-heaps and burial-mounds along the St. John's and the coast. The report and map by Mr. Le Baron will prove of considerable interest and importance in connection with the arrangement of the large amount of material which we have from the shell-heaps of Florida, consisting principally of the collections made by the late Prof. Wyman, and the proper time for its publication will be when the collections in that department of the museum shall be placed on exhibition.

THE DEPARTMENT OF ANTHROPOLOGY OF THE BRITISH ASSOCIATION, HELD IN SHEFFIELD, 1879.—The Report of this Association is a model in punctuality and preparation. The following is a correct list of papers.

BALL, V.—On the forms and geographical distribution of ancient stone implements in India.

CAMERON, COMMANDER.—On the manners and customs of the people of Urua, Central Africa.

CLARKE, HYDE.—On the Yarra and the languages of Australia in connection with those of the Mozambique and Portuguese Africa.

On High Africa as the center of a white race.

DAVIS, JAMES W.—On the discovery of certain pockets of chipped flints beneath the peat on the Yorkshire moors, near Halifax.

On an elaborately finished Celt found on the moors, near Marsden.

DAWKINS, W. BOYD.—On the geological evidence of the antiquity of Man.

DE BRAZZA, COMTE SAVORGNAN.—On the native races of Gaboon and Ogowé.

FARRER, J. A.—On savage and civilized warfare.

HARRISON, J. PARK.—The profile of the ancient Greeks.

KEANE, A. H.—On the relations of the Indo-Chinese and Inter-Oceanic races and languages.

KNOWLES, W. J.—On flint implements in the Valley of the Bann.

On some curious leathern and wooden objects from Tullyreagh bog, County Antrim.

LANG, ANDREW.—On the origin of Fetichism.

MILNE, JOHN.—On the stone-age in Japan.

MOSS, EDWARD L.—On a collection of organic remains from the Kitchen-middens of Hissarlik.

OPPERT, GUSTAV.—On the classification of languages on the basis of ethnology.

RENÉ, DR.—On the discovery of animal mounds in the Pyrenees.

Evidence of early historic events and pre-historic customs by perpetuation of design in art and manufacture in later, and even in present, times.

PINTO, DE SERPA.—On the native races of the head-waters of the Zambesi.

ROBERTS, C.—A classification of the physical conditions of life.

SKERTCHLEY, SYDNEY B. J.—Evidence of the existence of palæolithic man during the glacial period in East Anglia.

On a new estimate of the date of the neolithic age.

On the survival of the neolithic period at Brandon, Suffolk.

TUKE, D. HACK.—On the Cagots.

TYLOR, E. BURNETT, Chairman.—The presidential address.

TYLOR, A.—On certain inventions illustrating the working of the human mind.

VAMBÉRY, ARMINIUS.—On the Turcomans between the Caspian and Merv.

WAKE, C. STANISLAND.—Notes on the Polynesian races.

ARCHÆOLOGY IN INDIANA.—The volume containing the eighth, ninth and tenth annual reports of the geological survey of Indiana during 1876–77–78, by Prof. E. T. Cox, devotes the space from page 121 to page 153 to antiquities. In the first chapter descriptions and surveys of new works and mounds are given accompanied by accurate maps. The second chapter is an address by Mr. Cox before the State Archæological Association of Indiana, which closes with this most excellent sentence, "Let us, therefore, attend strictly to detailing facts of observation, and they are sure to lead to a correct solution of all problems within the compass of the human mind."

ANTHROPOLOGICAL NEWS.—Tenth general meeting of the German Anthropological Society, at Strassburg, on the 11th, 12th and 13th of August, 1879, in Cor.-Bl. d. Deutsch. Gesellsch. f. Anthrop., etc. Nos. 9, 10 and 11. The papers and discussions reported are of great importance locally, but few of them were of general interest. Mr. E. Von Tröltsch presented a prehistoric chart of Southern Germany and Switzerland, which is a marvel of patience and skill in the use of graphic signs and colors.

The second part of the twelfth volume of *Archiv für Anthropologie*, 1879, contains the following communications:

Der Steisshaarwirbel (vertex coccygeus), die Steissbeinglaze (glabella coccygea), und das Steissbeingrübschen (foveola coccygea), wahrscheinliche Ueberbleibsel embryonaler Formen, in der Steissbeingegend beim ungeborenen, neugeborenen, und erwachsenen Menschen; by A. Ecker, with two plates, pp. 129–156.

Kraniologische Untersuchungen, by Dr. Emil Schmidt (Fortsetzung und Schluss), pp. 157–200.

Ueber die prähistorischen Opferstätten am Uralgebirge, by Alexander Teplouchoff in Illinskoje near Perm (with two plates).

Neuer Messapparat für photographische Aufnahmen von Lebenden und von Schädeln oder skeletten, by Dr. Gottschow (with one plate).

Kleinere Mittheilungen, including notices of the Moscow Exposition, Gatschet's "Adjectives of Color," Kulischer's "Jus primæ noctis," and Wankel's "Prähistorische Eisenschmelz und Schmiedestätten in Mähren."

Prof. Ecker, the author of the first article, published in Globus, 1878, XXXIII, 177, a paper upon abnormal hairiness in men, especially with reference to the so-called hairy men. The present paper is a continuation and extension of those studies in thoroughness, although a great restriction of the area of observation. While the author was endeavoring to ascertain the significance of distribution of hair over the fœtus in general, and of the *trichosis sacralis* in particular, his attention was arrested not only by the hair-whorl near the coccyx, but also by the bald place (glabella), and the dimple (foveola coccygea). The author, after making these discoveries independently, found that others also had mentioned the dimple and the hair-whorl, while the *glabella* had not been noticed at all, and the connection of all these characteristics into a single study was entirely original with him. The design of the paper is to describe the phenomena separately, to ascertain their mutual relationships, and to arrive, if possible, at their origin and meaning.

The Bureau of Ethnology at Washington, designing in the future to publish a large work upon the gesture speech of mankind, has issued a preliminary quarto *fasciculus* of seventy-two pages prepared by Col. Garrick Mallery, and entitled, "Introduction to the study of the sign language among the North American Indians as illustrating the gesture speech of mankind." The final publication will be a collection of all signs, symbols and facial expressions used in conveying thought, by deaf-mutes and by tribes beyond North America, as well as by our own aborigines.

The writer dwells first upon the practical value of the sign language both in communication with living tribes and for the interpretation of native picture writing, "the sole form of aboriginal records, the impress upon bark, skins, or rocks of the evanescent air picture which in pigment or carving preserve their skeleton outline." The next chapter treats of the origin and extent of gesture speech, holding that the latter preceded articulate language in importance, which remained rudimentary long after gesture had become an art. The preponderance of authority is to the effect that man, when in possession of all his faculties, did not make a deliberate choice between voice and gesture, both being originally instinctive, as both are now; and there never was a time when one was used to the exclusion of the other. With the voice he at first imitated the few sounds of nature, while with gesture he exhibited actions, motions, positions, forms, dimensions, directions, distances, and their derivatives. It is enough to admit that the connection between them was so early and intimate that the gestures, in the wide sense of presenting ideas under physical forms, had a formative effect upon many words; that they exhibit the earliest condition of the human mind; are traced from the remotest antiquity among all peoples possessing records, and are universally prevalent in the savage stage of social evolution. Col Mallery next proceeds to demol-

ish the oft-repeated story that there are tribes that cannot converse in the dark, alleging in response that individuals of those American tribes especially instanced, often in their domestic *abandon*, wrap themselves in robes or blankets with only breathing holes before the nose, and chatter away for hours. The common belief in an universal sign language shares the same fate at the hand of the author. In numerous instances there is an entire discrepancy between the signs made by different bodies of Indians to express the same idea. The pages of authorities, 16–18, are given in corroboration of the author's view. Then follows a series of variant signs, diverse both in conception and execution, with further illustrations, including speeches and stories in signs, with advice to collectors, accompanied with drawings to guide them in recording their observations.

We have called attention previously to the *American Art Review*, edited by Messrs. S. R. Koehler, Wm. C. Prime and Charles C. Perkins, and published monthy, in Boston, by Estes & Lauriat. As a medium of communication between students of the fine arts, it does not come within the pale of our notice; but the editors, taking the view that art is a factor in civilization, have engaged the most distinguished specialists, including Mr. Bancroft and Prof. Putnam to contribute an illustrated paper to each number upon American aboriginal art in its ancient and modern phases. In this view the journal commends itself to the archæologists of our country as eminently worthy of their support.

The following titles of works and treatises may draw attention to something of interest to our readers. They are compiled chiefly from *The American Bookseller* and *Index Medicus:*

Antiquary: A magazine devoted to the study of the past. Edited by Edward Walford. J. W. Bouton, N. Y.

Antropologicheskaja vistavka, 1879, go goda (Anthrop. Exposition at Moscow in 1879.) Moskva, 1879.

Aryas, Discussion sur l'origine des. *Bull. Soc. Anthrop. de Paris*, 1879, II, 344, 443.

AYRTON, MATILDA CHAPLIN.—Recherches sur les dimensions générales et sur les développement du corps chez les Japonais. Paris, 1879.

B., J.—Statistique anthropométrique et médicale des élèves des écoles primaires de Bruxelles. *Ann. de demog. internat.* Paris, 1879, III.

BEARD, G. M.—English and American physique. *N. Am. Rev.* 1879, CXXIX.

BENEDIKT, M.—Ueber Kraniometrie. *Centralbl. f. Nervenh.* Coblenz, 1879, II.

BLEICHER.—Essai sur les temps préhistoriques en Alsace. Nancy, 1879.

BORLASE, W. C.—Indian money cowrie in a British barrow. *Antiquary*, Jan.

BORDIER.—Sur les crânes d'assassins. *Bull. Soc. d'Anthrop. de Paris*, 1879.

BROCA, PAUL.—Crâne et cerveau d'un homme atteint de la deformation toulousaine. *Bull. Soc. d'Anthrop. de Paris*, 1879, II.

Sur la determination de l'âge moyen. *Bull. Soc. d'Anthrop. de Paris*, 1879, III.

Sur un crâne de Fellah et sur l'usure des dents. *Bull. Soc. d'Anthrop. de Paris*, 1879, II.

BUJACK.—Auszug aus dem Catalog der Sammlung der Allerthumsgesellschaft Prussia. *Arch. f. Anthrop.*, 1879, XII, 75–89.

COTTEAU.—Les sciences anthropologiques a l'exposition universelle de 1878. Auxerre, 1879.

DUBNIDON, P.—Le Culte des Morts et les Cimetières. *Rev. Occidentale*, Jan.

DURAND.—Sur les races nobles de l'Aveyron. *Bull. Soc. d'Anthrop. de Paris*, 1879, II, 421.

GARCIN, C.—La tête et le crâne d'un Neo-Caledonien. *Marseille Med.*, 1879, XVI.

GEOFFROY, J.—La connaissance et la denomination des couleurs. *Bull. Soc. d'Anthrop. de Paris*, 1879, II.

GIGLIOLI, E. H.—Nuove notizie sui popoli negroidi degli Asia e specialmente sui Negriti. *Archiv. per l'Anthrop.* Firenze, 1879, IX.

GIRARD, J.—Migrations Africaines. *Bull. d. l. Soc. Geographie*, Oct.

GOMME, G. L.—Folk-lore and the Folk-lore Society. *Antiquary*, Jan.

HOFFMANN, W.—Russian Superstitions. *Penn Month.*, Jan.

Instructions générales pour les recherches anthropologiques à faire sur le vivant. Paris, 1879.

KOTELMANN, L.—Die Augen von 9 Lapländern, 3 Patagoniern, 13 Nubiern, und 1 neger vom weissen Nil. *Berlin Klein Wchnschr.*, 1879, XVI.

LE BON.—Des differences de volume du crâne suivant les races, les individus, et les sexes. [Extract from his memoir crowned by the Soc. d'Anthrop. de Paris with the first prize.] *Gaz. d'hôp.* Paris, 1879, LII.

LEBON, G.—Resultats fournis par la mesure des capacites de crânes ayant appartenu a des hommes célèbres. Compt. rend. Acad. d. Sc. Paris, 1879, LXXXIX.

Marriage Proposals, Curious. *Chambers' Journ.*, Jan.

MEEH, K. Oberflächenmessungen des menschlichen Körpers. *Ztschr. f. Biol.*, München, 1879, XV.

MODEGLIANI, L.—Di alcune linee faciali trasverse nel cranio di varie razze. *Arch. per l'Antrop.* Forenze, 1879, IX.

MONTAGUE, C.—About Kissing. *Potter's Am. Month.*, Feb.

PARKER, Dr. A. J.—On the brain of a Chimpanzee. *N. Y. Medical Record*, Jan.

RAMON DE TORRES MARTINEZ, J.—Contribucion a la antropologia, Forma el hombre un reino aparte dentro del órden de la creacion? *Encicl. méd.-farm.* Barcelona, 1879, III.

RICE, L.—The Ganga Kings. *Madras J. of Literature*, I.

ROTH, E.—Beitrage zur Erblichkeitsfrage. *Berlin Klin. Wchnschr.* 1879, XVI.

SABIN, JOSEPH—A Dictionary of Books relating to America. Parts 60–70. Joseph Sabin and Sons, New York.

SCHÖLER—Ueber die Stellung der Ophthalmologie zur Anthropologie. *Arch. f. path. Anat.* Berlin, 1879, LXXVIII.

STAGE, G. G.—Weight in the first year. Copenhagen, 1879.

TARUFFI, C.—Dell' antropometria e delle anomelie della colona vertebrale. *Ann. univ. di med. e chir.* Milano, 1879, CCXXLIX.

VAUGHN, MGR.—L'Homme: son origine, sa destinee. *Annales d. Philos. Chretienne*, Jan.

Vedas, Antiquity of the. *Theosophist*, Oct., 1879.

WEISGERBER, HENRI.—De l'indice thoracique. Paris, 1879.

WEST, E. P.—A buried race in Kansas. *Kansas City Rev.*, Jan.

WIENER, C.—Gran Chimu et la ville de Cuzco. *Bull. d. l. Soc. de Geog.*, Oct.

WOINARSKI, S. E. A. Z.—Some statistics of the length and weight of children born in the Lying-in Hospital, Melbourne. *Austral M. Journ.* Melbourne, 1879, I.

GEOLOGY AND PALÆONTOLOGY.

A NEW GENUS OF TAPIROIDS.—In 1873 I obtained the anterior part of the skeleton of a tapiroid mammal from the Eocene beds of the Washakie basin in south-western Wyoming. Having recently had occasion to examine the specimen, on removing the matrix I was surprised to find that it only possessed three digits

in the anterior foot, the fourth (fifth) being represented by a rudimental metacarpal. It thus differs from *Hyrachyus*, and allied genera of the Eocene, and places itself in direct association with the three-toed forms of the Lower Miocene. The dentition is however that of *Hyrachyus*. The premolars differ from the true molars in form, and the transverse crests of the latter are uninterrupted. There is a diastema, in which it differs from (*Helaletes*) *Tapirulus*. (See Scott, Osborn and Spier on this genus.) The inferior molars are like those of the rhinoceroses. The ulna and radius are distinct. I call this genus thus characterized, *Triplopus*, and the species *T. cubitalis*, with the following description:

The interorbital region of the skull is wide and flat, and the sagittal crest is low. The muzzle is rather short, and the anterior border of the orbit marks about the middle of the first true molar. The posterior external crescent of the superior true molars is without bounding or dividing ridge, while the median ridge of the anterior crescent is very strong. The same is true of the confluent crescents of the premolars. The crests of the inferior true molars have strong ridges descending anteriorly from their outer extremities. The fore-limb, especially the cubitus, is rather slender. Length of superior molar series, m. .055; of true molars, .030; of superior diastema, .012; interorbital width, .049; length of humerus, .111; of radius, .143; of median metacarpus, .066; of median digit, .028. The species was about the size of a fox. The form has a good claim to be regarded as the type ancestral to *Hyracodon*.—*E. D. Cope*.

THE STRUCTURE OF THE PERMIAN GANOCEPHALA.—Examination of abundant material shows the correctness of my anticipation (this Journal 1878, 633), that the vertebræ of the large batrachian *Eryops*, would turn out to have the structure found in *Rhachitomus*. This genus then must be referred to the same sub-order as *Trimerorhachis*, and probably *Actinodon* Gaudry, which will be characterized by the segmented vertebral centra. If European authors are correct in stating that the vertebræ of the *Labyrinthodontia* have undivided centra, the sub-order above mentioned, must probably retain the name of *Ganocephala*, with additional characters.

The identification of the scapular arch in *Eryops*, and of the pelvic arch in *Eryops* and *Cricotus*, gives the following results: The glenoid cavity is an excavation in two coössified elements, of which the inferior and posterior is probably coracoid. The latter is then much smaller than in *Reptilia* and *Batrachia anura*, but resembles that of the salamanders. The scapular arch proper, resembles that of the *Urodela*. The pelvis is intermediate between that of the anurous and urodelous *Batrachia*. There is no obturator foramen, and the common symphysis is deep. The humerus closely resembles that of the *Pelycosauria*, differing chiefly in the non-enclosure of the supracondylar foramen.

The resemblance of the scapular and pelvic arches of the *Pelycosauria*[1] to those of the *Batrachia* above described, is remarkable. In *Dimetrodon* and *Clepsydrops*, the principal difference to be observed in the pelvis, is the much stronger attachment of the ilium to the sacrum. In the scapular arch the principal peculiarity in the coössified portions, is the posterior double emargination of the coracoid. It is thus evident that in the Permian period there was a much closer approximation between the Batrachian, Reptilian and Mammalian types than at any later period. —*E. D. Cope.*

Buthotrephis from York County, Pa.—Prof. Frazer has recently obtained specimens of *Buthotrephis flexuosa* from the Peach Bottom Slate quarries, near the Susquehanna river. The slate of this region, according to Prof. Frazer, is bounded, both above and below, by chlorites of great thickness, which have been heretofore regarded as lying much below the palæozoic rocks. As the *Buthotrephis flexuosa* is characteristic of the Hudson river epoch at the summit of the Lower Silurian, this discovery disturbs views previously held, and opens up new questions in the stratigraphy of the region.

The Comstock Lode.—The scientific history of the Comstock has had three periods of development. First came in 1865, Von Richthofen, who had carefully studied the eruptive rocks of Transylvania, and was able to settle, once for all, the grand features of Washoe geology. He showed that the country rock of the Comstock was made up of four principal members, which are: diorite, at the base; propylite, overlying it; andesite, disposed in dikes through the mass of both these rocks; and finally trachyte, which seems to have no immediate connection with the diorite, but lies entirely in and upon the propylite. These four rocks were laid down in the order named. To this mass of information Mr. Clarence King, in 1870, added not only a careful discussion of the shape and occurrence of ore-bodies, but also the grand fact, not perceived before, that the lode lies upon one of the dikes of andesite. For the rest, it was supposed that the diorite had been injected as a dome into a mass of sedimentary strata, the remnants of which are still observable, and that it already formed a mountain peak before propylite, the succeeding rock, appeared. When the latter did come, it poured in irregular floods, covering the diorite mountain nearly or quite to its summit. The andesite was thought to have been injected into cracks broken through this vast mass of propylite; while the trachyte was looked upon as the real lode-maker.

The convulsions which attended its appearance were supposed to have opened a great crevice into which poured the waters from which the ore was deposited.

[1] See this Journal, 1878, p. 829.

Prof. John A. Church has recently written a book on "The Formation and History of the Comstock Lode." His account of Comstock geology differs essentially from this. He concurs with his predecessors in regard to the position and order of the rocks and the presence of a dike under the lode; but he gives to the rocks and to the lode itself a different history. He finds that the diorite and propylite are both stratified, and their strata are approximately conformable.

They were laid down in the horizontal position, and have been elevated into a mountain range by the ordinary operation of pressure and folding. The dikes of andesite have not broken through cracks opened across the other rocks, but are bedded, interposed between the strata of diorite and propylite. The openings between these strata were not originally so thick as the quartz seams now are. At first they were the merest partings between two layers of the propylite; and in accounting for the development of these insignificant crevices to ore-bodies two and three hundred feet thick, Mr. Church advances one of the most important observations of his book.

He takes the bold ground that the Comstock is not a true fissure vein; but that it has been formed by the process of substituting quartz for the propylite in certain localities, which were prepared for the process in a way described by him.

The lode lies on one of the andesite dikes, and the metal-bearing water rose up the face of this dike, and penetrated the propylite strata whenever they had been opened.

This water was siliceous, and attacked the propylite rock, dissolving it and depositing silica in its place. Each layer of propylite was attacked on two sides, until finally the whole layer was removed, and the two seams of quartz met. The layers of propylite are of all thicknesses, from a few feet up to many yards, and when a number of them were involved in the process of substitution, some would be completely removed, when others were only half dissolved away. If the process of substitution stopped at this stage, the result would be a mass of quartz inclosing streaks and layers of propylite, just as the structure is found to exist at the edges of the quartz bodies.—*Engineering and Mining Journal.*

GEOGRAPHY AND TRAVELS.[1]

ASIA.—Col. Prejevalsky having passed through Bulun-tochoi, up the Urungu river, crossed the southern Altai mountains to Barkul, arriving at Hami about May 30, 1879. Hami is at the extremity of the sandy steppe described as the Mouschoun Gobi; it is a desert almost destitute of vegetation with great tracts of clay covered with gravel. While the temperature of the air was as high as 38° C., the soil had sometimes a temperature of 68° C. The only animals of large size seen were the antelope and wild camel. Prejevalsky crossed this desert in a south-eastern

[1] Edited by ELLIS H. YARNALL, Philadelphia.

The resemblance of the [redacted]
cosauria[1] to those of the [redacted]
ble. In *Dimetrodon* and [redacted]
be observed in the pelvis, [redacted]
ilium to the sacrum. In [redacted]
liarity in the coössified [redacted]
nation of the coracoid. [redacted]
period there was a much [redacted]
trachian, Reptilian and M[redacted]
—*E. D. Cope.*

BUTHOTREPHIS FROM [redacted]
cently obtained specimens [redacted]
Bottom Slate quarries, n[redacted]
this region, according to [redacted]
below, by chlorites of gr[redacted]
regarded as lying much [redacted]
Buthotrephis flexuosa is c[redacted]
at the summit of the Lo[redacted]
previously held, and ope[redacted]
of the region.

THE COMSTOCK LOD[redacted]
has had three periods o[redacted]
Richthofen, who had [redacted]
Transylvania, and was [redacted]
features of Washoe geo[redacted]
of the Comstock was m[redacted]
are: diorite, at the ba[redacted]
posed in dikes through [redacted]
trachyte, which seems t[redacted]
diorite, but lies entirel[redacted]
rocks were laid down [redacted]
formation Mr. Clarence [redacted]
discussion of the shape
grand fact, not perceive
dikes of andesite. Fo
had been injected as
the remnants of whi
formed a mountain pe
peared. When the la
covering the diorite n
andesite was though
through this vast mas
upon as the real lode
The convulsions w
to have opened a gre
which the ore was de

[1] See this Journal, 1878,

[redacted]au—about E. long.
[redacted] of June. He states
[redacted]on of 5000 feet, but
[redacted] is very fertile, is only
[redacted] runs a range covered
[redacted] dentified with the Altyn-
[redacted] It is here joined by
[redacted] of Mongolia being
[redacted] of it will be much
[redacted] traveler comes by way
[redacted] the southern part of
[redacted] frontier of Tibet. The
[redacted] partly through Prejeval-
[redacted] from Huc and Gabet's

[redacted] NATURALIST for No-
[redacted] attempt to cross the
[redacted] journey southwards from
[redacted] the northern bound-
[redacted] turning to Su-chow-fu he
[redacted] through a mountainous
[redacted] Tatung, a tributary to
[redacted] the limits of perpetual
[redacted] is situated at the foot
[redacted] feet), in a well cultivated
[redacted] rhubarb trade between
[redacted] to reach Lhassa by the
[redacted] Tibet, the road followed by
[redacted] farther than the Odantala
[redacted] The party left Si-ning-fu on
[redacted]-fu, the capital of Szech-
[redacted] This route is quite unknown,
[redacted] great rivers, the Yellow
[redacted] arrival on the 24th of October
[redacted] Pekin. Notwithstanding the
[redacted] from continuing his jour-
[redacted] of the natives of that
[redacted] continuing his journey to

[redacted] are slowly being developed.
[redacted] field has been found extend-
[redacted] In one bed lying only a
[redacted] 1,200,000 tons of anthra-

[redacted] of the British Consul at

[redacted] Prejevalsky's route we have found
[redacted] showing his previous journey in

Saigon, Cochin China, that the natives of the country, especially in the more northern districts of Indo-China, have the great toe of the foot separated from the others like the thumb of the hand, so that it can be used, in a limited degree, in the same way. This peculiarity is mentioned in Chinese annals so far back as 2300 B. C.

Several Russian travelers have recently made important explorations in Central Asia. M. Potanin has solved many important questions connected with the geography of north-western Mongolia and made valuable natural history and ethnological collections. M. Severtsof has, by a recent exploration of the Pamir, made considerable additions to our knowledge of its physical and geographical features. Some of the peaks in the Pamir were found to be of great height—the Mustagh attaining an elevation of 25,800 feet. The snow line was found to be at 14,000 feet on the northern, and at 19,000 feet on the southern slope of the mountains.

M. Oshanin describes a visit to the upper part of the Muk-sou, a tributary of the Surkhab river. From a notice of his paper in *Nature* we learn that very high peaks inclose the deep valley of this stream, the bottom of which is 8000 feet above the sea level. The Sandal peak is 25,000 feet high. These peaks are covered for two-thirds of their height with snow, and immense glaciers flow from their wide amphitheatres into the valley of the Sel-su river and those of its tributaries. They form together a glacier which descends very low, its lower extremity, one and a-half miles wide, being met with at a distance of fifteen miles from Altyn-mazar at the confluence of the Sel-su, Luk-su and Kainda rivers. The length of this glacier is not less than twenty to twenty-five miles, and it is fed with several other glaciers of very large size. The oscillations in its length have a great importance, as sometimes it advances so far into the valley as completely to bar up the valley of the affluent of the Sel-su, the Baland-kiik; this last thence forms a wide base which afterwards cuts through a passage in the ice and inundates the main valley, destroying the forests. The vegetation in the neighborhood of the glacier is very poor, whilst the lateral valley of the Baland-kiik is covered with rich forests and grass, though far higher than that of the Sel-su. M. Oshanin observed immense quantities of the *Microplax interrupta* Fieb., in the neighborhood of Altyn-mazar. This *Oxycerenina*, which is characteristic of the southern parts of the palæarctic region in Europe, reaches in Central Asia such heights as, in the Alps and Pyrenees, are occupied with representations of the Arctic zone.

M. Fetissoff, the director of the Botanical Garden at Vernoe, has demonstrated that the supposed volcanoes in the Kuldja district are really coal beds in a state of combustion.

Another Russian explorer, M. Pyevtsoff, has traveled from

direction for 232 miles to the oasis of Sha-chau
94°, lat 39°[1]—reaching there on the 20th of
that the desert attains at one point an elevation
that the Sha-chau oasis, which he describes as ve
3500 feet above the sea. Southwards there run
with perpetual snow, and evidently to be identifie
tagh of his former journey to Lob-Nor. It is
the Nian-Shan of Koko-Nor. This portion of
very little known, it is likely our knowledge of
increased. The latest news of this intrepid travel
of Pekin, and reports him as having reached the
the province of Tsaidam on the northern frontier
route from there to Lhassa is known, partly t
sky's own researches in 1872, and partly from
journey.

Count Széchényi having, as stated in the NA
vember, 1879, been obliged to abandon his atte
Kum Tagh to the Lob-Nor, made a journey
Su-chow-fu, visiting the high range forming the
ary of the plains of Tsaidam. Then returning
proceeded south-easterly to Si-ning-fu through
region constituting the basin of the river Tatu
the Yellow river. These mountains attain the li
snow and are called Nan Shan Si-ning-fu is si
of lofty snow-clad mountains (14,500 feet), in
country, and is the principal depot of the rhuba
China and Russia. He next endeavored to rea
direct route over the high plateau of Tibet, th
Père Huc, but could not advance further t
plain where the Yellow river rises. The part
August 12, 1879, and reached Cheng-tu-fu, th
uen, at the beginning of October This route
and passes over the water-sheds of the two gre
and the Yang-tse-kiang. Széchényi's arrival
at Ta-chiên-lu has been reported at Pekin.
efforts of the Chinese to dissuade him from
ney into Tibet and the reported hostility
country, he, when last heard from, was con
Batang and Lhassa.

The immense coal fields of China are s
On the upper Yang-tse-kiang a coal field
ing over seventy-five square miles. In
hundred feet from the surface at least
cite have been exposed.

The *Academy* states, on the authority

[1] The best map on which to trace this portion of
to be Tafel 1, *Petermann's Mittheilungen*, 1876,
1870–73 —EDITOR.

Kobdo to Kalgan, and thence to Ulassoutai via Urga, in Mongolia. From Ulassoutai he turned west to the Chuyra river, which was reached at Kosh-agach. Nearly the whole of this journey was through unexplored territory. No less than 2700 miles were surveyed and twenty-six points determined astronomically as well by chronometer as by occultations. Barometrical measurements were made during the whole journey, and very rich zoölogical, botanical and mineralogical collections were obtained.

Bangkok, the capital of Siam, is to be united to the telegraphic system of the world by a partly overland and partly submarine line connecting with the one now running to Moulmein.

M. W. Shapira sends to the *Athenæum* (March 13, 1880) an interesting account of a journey of four months during the summer of 1879 in the interior of Yemen, the Arabia Felix of the Romans. He describes it as the most fertile and temperate country on this side of Asia, owing its happiness chiefly to the absence of the Shumum winds—the great curse of Syria and Northern Africa—and its prosperity to its having two rainy seasons of four months each, and consequently two harvests in the year. The mountains make the climate temperate and healthy. Yemen has an area of about 50,000 miles, more than half of which belongs to a series of plateaux from 4000 to 8500 feet above the level of the sea The boundary line of Yemen is as follows: western side, along the eastern side of the Red sea, from Bab el-Mandab south to Lohaya north; then north side, from Lohaya north-west to Saada north-east; then from Saada north-east to Aden south-east; then from Aden south-east to Bab-el-Mandab south-west, so that it forms an oblong square of about 110 to 150 miles wide and 450 long. The chief towns of Yemen are situated on the second plateau, from 6000 to 7000 feet above the sea. This plateau is fertile and well watered.

MICROSCOPY.[1]

ORGANISMS IN ICE FROM STAGNANT WATER.—During the past season on account of the unusually mild weather, ice has been gathered quite extensively from stagnant water in canals and ponds. Since the middle of February I have been making microscopical investigations with regard to the purity of such ice. The plan adopted has been to select only those fragments taken from the interior of blocks which appear clean and transparent to the unassisted eye. On melting those fragments and examining the water thus obtained with various magnifying powers up to 900 diameters, bits of vegetable tissues and confervoid growths are usually recognizable at once. I have not noticed animalculæ in an active state in water from ice that has just been melted, but upon allowing such water to settle and become warm at the or-

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

dinary temperature of a room occupied for living purposes, the sediment deposited may be found to contain, after some hours, monads whose movements are easily discernible with a magnifying powers of from 200 to 400 diameters. Upon allowing the water to stand still longer I have found the confervæ growing thriftily, and in some instances forming clusters or bundles frequented by minute animalculæ, the entire appearance in this case being very similar to that presented by the nests occupied by the young of the common *Paramecium* which I have seen in stagnant water. As the result of these investigations I am fully convinced that freezing does not free water from filth due to the presence of sewage or decaying vegetable matter, and further, that it is altogether probable that the germs from which animalculæ are developed, if not the animalculæ themselves in a quiescent state, are present in very much of the ice taken from stagnant water. This being the case, it would seem that the use of such ice in drinking water is hazardous, to say the least.—*M. A. Veeder, Lyons, N. Y.*

AMERICAN SOCIETY OF MICROSCOPISTS.—The Executive Committee of this Society has decided upon Tuesday, August 17th, as the date of the coming meeting at Detroit, which is expected to continue four days. Ample arrangements are already being made for the entertainment of the Society by the local Microscopical Club.

——:o:——

SCIENTIFIC NEWS.

— EDITORS NATURALIST.—The severe criticism upon a short paper on the Entomostraca, which I published in the Report of the Minnesota Geological Survey, seems to admit of a reply.

The writer is not uncognizant of numerous faults in the paper, but is not willing to renounce the hope, expressed in the preface, that it will be of some slight service to those for whom it was designed.

The reviewer seems to ignore the design of the paper and the avowal of the author, which cover most of the points criticised.

It was intended as an aid to those who are interested in such humble forms, but are unable to secure the numerous foreign works necessary to obtain a complete view of the group.

The definition of the new species was but an incidental feature.

The names of the sources of information used are, for the most part, mentioned in the preface, so it is obvious the harsh criticism on this point is uncalled for.

The statement that no credit is given for facts and bibliographical lists is covered by that fact, and the instance cited *(Daphnia pulex) does* contain references to Baird's work.

The animus of the criticism is visible in the fact that the reviewer deplores the absence of reference, in one case at least, to

works not published at the time the MS. was submitted If it be a crime for an almanac to differ from an encyclopedia, there are many sinners. If the paper had been intended as a revision of the classification rather than a mere annotated list with references to such works as were consulted for assistance of amateurs, the severity might seem merited.

Finally, typographical errors are to be greatly regretted, and the genius of the compositor who renders *gnathites* qualities, borders on the sublime, yet any one who has attempted to secure a correct rendering of scientific names from compositors unfamiliar with them, will readily understand that the lack of opportunity for second reading of proof might cover many sins; however, Mr. Kingsley has compiled a quite complete list of errata, covering the important errors.

In conclusion the writer would add that the paper was collected from notes gathered at different times for another purpose, and the material was given its present form for reasons mentioned, and not without the advice of those of greater experience.

The present intention is to continue the study with the assistance of works which unfortunately came too late to be used in the preparation of the paper, and assistance and advice is solicited and will be reciprocated as far as possible.

My thanks are due Mr. Kingsley for his attempt to correct any errors which might mislead, and are respectfully tendered.—*C. L. Herrick.*

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Academy of Natural Sciences, Philadelphia, Jan. 13—. Profs. C. N. Pierce and E. D. Cope were dropped from the council on account of absence from more than six of the meetings; Prof. Cope having been engaged in a scientific exploration in Oregon. Their re-nomination was refused on the ground that the exclusion from the council is of the nature of a penalty for the absence in question.

Dr. H. C. Chapman remarked on the genito-urinary organs of *Capromys piloroides* (clitoris perforated by the urethra), and on the occurrence of *Cysticerci* in the Macaque.

Jan 18—In response to a resolution of the Academy, the following communication from Prof. Cope was read:

Dr. E. J. Nolan.

Sir:—Yours of the 14th inst. containing a copy of a resolution of the Academy of Natural Sciences, is received. The resolution requests a statement of the grounds on which were based certain assertions which I have made in the Philadelphia *Record* for Jan. 8th, 1880. I take great pleasure in furnishing the desired information, as follows:

First statement. " It may be remarked that at the late election

the reform party polled more votes than at any previous election (48 votes)." Explanation: John S. Haines, one of the candidates of the reform party, received according to the official count, furnished me by a reliable person, forty-two votes by the ballots on colored paper, and six votes by the ballots on white paper, which were thrown out by the tellers. $42 + 6 = 48$. I take as a test of the previous strength of the reform party the vote on the final passage of the present by-laws, by which the professorships were established. After an open discussion of five months they were adopted by a vote of not more than thirty yeas and only two nays.

Second statement. "That they" (*i. e.* the reform party) "elected three out of their five candidates." The three candidates nominated by members of the reform party who were elected, are Dr. A. J. Parker, Edward Potts and Rev. H. C. McCook.

Third statement. "One of whom however" (*i. e.* one of the candidates of the reform party who was elected) "has been irregularly superseded." By this I intended to refer to the fact, that Dr. R. S. Kenderdine, having withdrawn from the candidacy for the position of curator in entire accordance with parliamentary law, was no longer a candidate. That the placing of his name on the ticket at a subsequent meeting by a ruling of the president, was an arbitrary act, done contrary to the continued ruling of the same president for years past, which has not permitted the placing of any name in nomination for office after the last Tuesday in November. To say then that Dr. A. J. Parker has been "irregularly superseded," is to state in the mildest language, a position of affairs, which it is hoped will be, in the interest of fair dealing, soon remedied. I am very truly yours, E. D. COPE.

Verbal remarks by Dr. Leidy on the occurrence of *Filaria immitis* in the dog. Mr. J. A. Ryder remarked on the utilization of electricity for the purpose of instantly killing mollusks in a fully extended condition.

Feb. 3.—Mr. J. A. Ryder spoke on the nucleus of the eggs of limpets, *Crepidula fornicata.*

Feb. 10.—Dr. H. C. Evarts remarked on the occurrence of *Cercaria hyalocauda* Hald.

Feb. 24.—Dr. Leidy described some Naid worms—*Aulophorus vagus* and *Pristina flagellum* named. Mr. J. S. Kingsley on the holothurian genus *Kolga.*

Mar. 2.—Dr. Leidy remarked on *Dytiscus* and *Mactra*; also, on *Filaria restiformis*, a new human parasite, 26 inches long. Mr. J. S. Kingsley on the structure of the eyes of *Limulus.*

Mar. 9.—Dr. Coates made a verbal communication on some ancient Peruvian pottery exhibited by him. Drs. Coates, Leidy and LeConte, on the ancient Cyclopean structures of Peru, Egypt, etc. Mr. J. A. Ryder described two myriapods, *Scolopendrella notacantha* and *S. gratiæ*, nov. sp.; also, some remarks on the position of the chlorophyll grains in certain *Vorticellæ.*

The following papers have been presented for publication:—Jan. 6. "On the Nudibranchiate Gastropod Mollusca of the North Pacific ocean, with special reference to those of Alaska," by Dr. R. Bergh of Copenhagen, Part II.—"The Terrestrial Mollusca inhabiting the Cook's or Harvey islands," by Andrew Garrett. Jan. 27. "Carcinological Notes, No. 2; Revision of the Gelasimi," by J. S. Kingsley. Feb. 17. "A description of a new Crustacean from the Upper Silurian of Georgia, with remarks upon *Calymene clintonii*," by A. W. Vogdes. Feb. 24. "*Pelagic Amphipoda*," by T. Hale Street, M.D., U.S.N.—"Carcinological Notes, No. 3," by J. S. Kingsley. Mar. 9. "Check-list of the Maioidea of the Pacific coast," by W. N. Lockington.

California Academy of Sciences, Feb. 16.—A complete catalogue of the Fungi of the Pacific Coast, compiled by Dr. H. W. Harkness and Justin P. Moore, was presented. An article by Justin P. Moore was read on "Edible Fungi." W. W. Lockington read an article entitled, "Is Evolution Immoral?"

New York Academy of Sciences, March 22.—Mr I. C. Russell remarked on the former extent of the Triassic rocks of the Atlantic slope.

Boston Society of Natural History, March 17.—Dr. M. E. Wadsworth discussed the iron ores of Lake Superior and their associated rocks.

American Geographical Society, March 23.—Chief Justice Daly delivered the annual address upon the geographical work of the world in 1878 and 1879.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

American Journal of Science and Arts.—March. The old river beds of California, by J. Le Conte. Note on the age of the Green mountains, by J. D. Dana. Western limits of the Taconic system, by S. W. Ford. Principal characters of American Jurassic Dinosaurs, by O. C. Marsh.

American Journal of Science.—April. History of some Precambrian rocks in America and Europe, by T. Sterry Hunt. Synopsis of the Cephalopoda of the Northeastern coast of America, by A. E. Verrill.

Jenaische Zeitschrift für naturwissenschaft.—January 31. The brain of Ammocœtes and *Petromyzon planeri*, with especial reference to the spinal-like brain nerves, by R. Wiedersheim The skeleton of *Pleurodeles waltli*, by R. Wiedersheim. O. and R. Hertwig continue their researches on the anatomy and histology of the Actinians. Special and general studies on the morphology and development of the Hydra, by W. Haacke.

Zeitschrift fur Naturwissenschaftliche Zoölogie.—March 1. The article of most general interest is by E. Nauck on the hard parts of the stomach of crabs.

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THE DOMESTICATION OF CERTAIN RUMINANTS AND AQUATIC BIRDS.

BY A. E. BROWN AND J. D. CATON.

The following correspondence will interest both naturalists and sportsmen:

ZOÖLOGICAL GARDEN,
PHILADELPHIA, FRIDAY, Nov. 7, 1879.

HON. J. D. CATON.

Dear Sir:—The large amount of information which I have gained from your valuable work on the Antelope and Deer of North America, together with your well known interest in all matters relating to the domestication of the Cervidæ, leave me little hesitation in taking up a small portion of your time on the subject. My experience with our mule deer (*C. macrotis*) has been very similar to yours, with the exception that the adults, two bucks and one doe, which were first procured by the Society four years ago, have all done well and are now in very excellent condition. In the summer of 1878, we bred two fawns, and during the past summer three more, two of these being twins, one of which died when two days old. The other four turned out just as yours have done; all were subject to diarrhœa, which was checked by the use of astringent food, as oak leaves and ragweed, to avoid as much as possible the giving of medicines, but in every case the disease returned. This summer I have regularly plied them with tonics, first iron water, from a spring near the garden, then sulphate of quinia, and finally gentian powders, with good effect for a while but without affecting the general result. In each case I have found on post mortem examination, a similar condition of things—the diarrhœa resulted from cancer of the stomach (except in the youngest,

some four months old, in which there was peritonitis, but no localized center of irritation); the general physical condition was poor, tubercles generally being found in the liver and spleen; in each case death was immediately owing to the presence of a fibrous clot in the heart, resulting from the generally impoverished condition of the animal. All had fed well or rather voraciously up to the day of death.

The females have never appeared to take much care of the young, and they have been weaned very early. I have about determined, if I have an opportunity to try again, to attempt to raise the young altogether by hand. This is, of course, always risky, but from past experience I am inclined to think it no more so than to leave them with the mother. It is very difficult to give them the proper amount of arboreal food, and its place has to be supplied mostly with ordinary dry food and grass, hay, a little corn, bran several times a week, either wet or dry as may seem to be desirable for the condition of the animal. I have not noticed in any of our specimens, the elongation of the hoof which you observed in yours. I will be exceedingly glad if you can give me any ideas or suggestions which would serve to promote my attempts to domesticate the species—as thus far I confess to a complete failure—the breeding of healthy offspring being the best possible measure of success in domestication.

It will not be uninteresting to you to know what my experience has been with other species of deer. We have had in the collection the following:

Moose (*Alce americanus*).
Caribou (*Rangifer caribou*).
Wapiti (*Cervus canadensis*).
Common deer (*C. virginianus*).
White-tailed deer (*C. leucurus*).
Mule deer (*C. macrotis*).
Mazame deer (*C. campestris*). }
Wood Brocket (*C. nemorivagus*). } South America.
Pudu deer (*C. pudu*). }
Fallow deer (*Cervus dama*). Europe.
Axis deer (*C. axis*). }
Sambur deer (*C. aristotelis*). } India.

All of five specimens of moose and eight of caribou have died at periods varying from three months to two years and five months,

in the moose, and not beyond nine months in the caribou, from hypertrophy of the heart; owing, in my opinion, in great measure to the impossibility of providing the proper kind and quality of arboreal food, and somewhat also to the climate and the limited range given them in a zoölogical garden. *C. canadensis* and *C. virginianus* have done well. We have bred a number of each and have lost none from natural causes, except some four or five fawns from improper care when first born. Of *C. leucurus* we have had but one specimen. The South American deer seem to be constitutionally weak. We have bred and raised several of *C. campestris*, as also of *C. aristotelis* and *C. dama*. In *C. axis* the female has had two abortions, and is now, I think, too old to breed. My experience with our prong-horn *(A. americana)* has also been similar to yours—they all die speedily from diarrhœa or hypertrophy of the heart; change of food and tonics seem to have no effect upon them. We have had some ten or twelve individuals, none of which lived more than fifteen months.

The only possible apology for so long a letter is the great interest of the subject, which I trust you will accept as sufficient to warrant the liberty, and I shall be glad to consider myself as under obligation for any result of your experience in the domestication of the mule deer, which you are at liberty to assist me with. I am, with much respect, your obedient servant,

ARTHUR E. BROWN.

I have just been much disappointed in losing a fawn of the Javan musk deer or Chevrotain *(Tragulus javanicus)*. The mother refused from the start to take any care of it, and I succeeded in keeping it alive for three days, by hand, but it was too delicate to stand handling and has just died. The little thing weighed less than three ounces, the adults being only about ten inches high.—*A. E. B.*

OTTAWA, ILLINOIS, November 10th, 1879.

ARTHUR E. BROWN, ESQ., Gen'l Supt. Zoö. Soc. Philadelphia:

Dear Sir:—I am just in receipt of your very kind and interesting letter of the 7th inst., and hasten to reply and thank you.

I have received no more mule deer since my book was published, and about that time I lost my last of that species and also of the Columbia deer (*C. columbianus*), I am satisfied that they cannot be successfully domesticated in my grounds. They either find something which does not agree with them or something is want-

ing which they require—most probably the former. And hence I think that closer confinement will promise better results.

I added seven more antelope (*Antilocapra americana*) to my grounds, but all died in the course of the summer. Indeed all my experiments with ruminants, *feræ naturæ*, whose natural habitation is confined to the United States, west of the Missouri river, have proved failures.

About two years since I received a mountain sheep (*Ovis montanus*)—a female, from General Miles, stationed at Fort Keogh, and in the spring following another (a young male), but in spite of every possible care, both have died with much the same complaints as the mule and Columbia deer. In less than a month after arrival diarrhœa set in and though arrested repeatedly it would always return. The male survived scarcely six months, the female nearly two years, but she grew but little and scarcely ever seemed well.

My Virginia deer continue to reduce in numbers till now I have not more than fifteen, though these seem to be vigorous and perfectly healthy, yet not prolific. I have turned my attention to hybridizing them with the Ceylon deer and the Acapulco deer (*C. acapulcensis*), which with the hybrids seem to be perfectly healthy and prolific. I think it remarkable that these small species of deer, from such great distances and warm countries, should be so hardy and prolific here—most of the thorough-bred does have had two fawns this year, and several of the hybrids to this buck brought from Acapulco have two fawns and all perfectly healthy. I consider these small deer a great acquisition. On some of the hybrids the metatarsal gland is wanting and on some it is present, while some will have it on one hind leg and not on the other.

My elk (*C. canadensis*), continue to do well and are so prolific that I have had repeatedly to reduce their number, and would be glad now to dispose of at least thirty. I have on an average about one old buck a year killed in battle, and sometimes another by some casualty, but all are healthy. Mine grow very large, and of all the Cervidæ they seem best adapted to domestication.

You mention among your other species of deer *Cervus leucurus*. After much study, I came to the conclusion that the *C. leucurus* was but a variety of *C. virginianus* and so stated in my work.

My efforts to acclimatize ornithological specimens have been interesting. The Canada goose (*Bernicla canadensis*), are very

easily domesticated. When taken adult, a month or two is sufficient to make them as tame as those that have been in the grounds for years. They are healthy and prolific.

The white fronted geese (*Anser cærulescens*) do not domesticate so readily, and have not reproduced, though they were observed to couple last spring.

The Hawaiian geese (*Bernicla sandvicensis*), which I brought over in the spring of 1878, have proved hardy and I trust will prove reproductive. They were well sheltered and cared for last winter, and came through in good order. Both geese commenced laying in April, one laid three and the other four eggs, but only one showed a disposition to set upon the eggs, and she, after attending to her business faithfully for ten days, tired of it and quit the nest, so they produced no goslings.

In the wild state they lay but two or three eggs, while in domestication they sometimes lay eight or ten.

Mr. Brickwood, Post Master General of the kingdom, who had them in domestication for many years, sometimes raised as many as ten in a brood.

In domestication they seem to have strong attachments and are fond of human society, one gander in particular has become very fond of me, and always greets me cordially, and will *talk* with me in a low, soft plaintive tone so long as I will indulge the humor.

They are less aquatic than the other geese. The foot is not more than half webbed. They take a bath scarcely once a day, and rarely remain in the water long. I once saw one with the tail under water as we see a hen when forced to swim. Their native habitat is the high volcanic mountains in the Island of Hawaii, where they breed among the lava beds, depending upon the pools which they find among the rocks for water, never going down to the sea. They are of strong flight in the wild state, though in domestication they show little disposition to fly. Altogether they are the most interesting water-fowl which I possess, and I hope another year to raise some of them from the only pair I have left. A few weeks ago I lost the other pair by a mink.

I can add little to your observations on Japanese and Chinese geese. The former is twice as large as the latter. These have black legs, while those have yellow. They are very noisy, fairly discounting the Guinea fowls.

I supposed I had a pair of sand-hill cranes (*Grus canadensis*),

till they were seven years old, when both laid eggs and have done so now for three years. They lay two eggs each upon the naked ground without the least appearance of a nest, and far away from the water. Last spring I procured a young male (as I suppose), but no two of the three ever associate together, as far as observed. One of the females sat about ten days upon her eggs last spring and then gave it up. The crows dined on the eggs of the others.

I hope in the future to write more fully my observations on the mountain sheep and the Hawaiian geese, both of which are interesting subjects of study and are not very thoroughly understood. Very truly yours, J. D. CATON.

——:o:——

THE CRITICS OF EVOLUTION.

BY J. S. LIPPINCOTT.

[*Continued.*]

Opposition of Dawson.—Prof. Dawson is also an inconsistent writer. In 1869 he published his "Modern Ideas of Derivation," an address to the students of McGill College, Montreal, in which he stated his belief, that Prof. Cope's hypothesis, as advanced in his "Origin of Genera," is the "most promising of all that have been announced," and as "holding forth the most promising line of investigation by which we may hope ultimately to arrive at more true expression of the law of creation with reference to organized beings." This was an admission that he was in accord with the evolutionists.

Prof. Dawson is among those who have attempted to harmonize Scripture and science. I am unable to see that they can at present be harmonized. and am confirmed in the belief in the difficulty, by the opinion of the ablest geologists with whom I have the good fortune to be acquainted. Moreover, Prof. LeConte, of the University of California, confirms this impression. He also has written and lectured largely upon this subject, for the benefit of the Young Men's Christian Association, and is a firm believer in the truths of revealed religion. LeConte candidly admits that all attempts to reconcile the Mosaic cosmogony with the results of science must be distasteful to the philosophical Christian. They must ever be but artificial and ingenious human devices. Far better to regard the books of Revelation and of

nature in the philosophical spirit, and simply to wait and possess yourselves in patience, for the questions in dispute will, ere long, adjust themselves as others have done. He has used them, he admits, in times past, "but now considers them almost like trifling with the words of Scripture and the teachings of nature."[1]

"He who believes the Scriptures to have proceeded from Him who is the Author of nature, may well expect to find the same sort of difficulties in them as are found in the constitution of nature." This passage is from the writings of Origen, "the father of biblical criticism and exegesis in Christendom," and is probably the text upon which Bishop Butler based his "Analogy of Religion, Natural and Revealed, to the constitution and course of Nature," "the ablest treatise on the philosophy of religion."

Prof. Dawson admits that "organizations styling themselves 'the Church,' whose warrant from the Bible is often of the slenderest, have denounced and opposed new scientific truths and persecuted their upholders, but they have just as often denounced the Bible itself, and religious doctrines founded on it." He remarks that "theology is not religion, and may often have very little in common with true religion or with the Bible. When discussions arise between theology and other sciences, it is only a pity that either side should indulge in what has been termed the *odium theologicum*, but which is unfortunately not confined to *divines*." "Perhaps," he continues, "the most troublesome opposition to science, or rather to the progress of science, has sprung from the *tenacity with which we hold to old ideas*." The science, which was at one time the best attainable, roots itself in men's minds and thus "becomes a difficult matter to wrench from its hold, and its advocates are too apt to invoke in its defense political, social and ecclesiastical powers, and to support it by the authority of revelation, even when this, rightly understood, might be quite as favorable to the new views."

A work by Prof. Dawson entitled[2] "The Story of the Earth and Man," is, by many, esteemed a forcible protest against evolu-

[1] "Religion and Science; a series of Sunday lectures on the Relation of Natural and Revealed Religion, or the Truths revealed in Nature and Scripture." By Joseph LeConte, Prof. of Geology and Natural History in the University of California. 1874.

[2] "The Story of the Earth and Man." By J. W. Dawson, LL.D., F.R.S, F.G.S. Toronto and Montreal, 1873, p. 339, which has been severely criticised by Dr. Asa Gray in "Darwiniana," pp. 245-251

tion. In it he attempts to explain the facts of nature on the theory of creation as opposed to evolution, while he denounces the advocates of Darwinism, and boldly asserts "that evolution as an hypothesis has no basis in experience or in scientific fact." This work was written in 1873. He has so well described the character of the obstructionist and irreconcilable in the extracts above given from a more recent paper,[1] that we may almost imagine that he had himself in view, and that larger knowledge of the accumulating facts of evolution has had some influence upon his position as respects its scientific basis.

Prof. J. W. Dawson is, I believe, the only naturalist of deserved reputation who repudiates the established truths of evolution; yet he deems it his duty to apologize for the supposed "conflict of science and religion," and in the *Princeton Review* for November, 1879, appeared the following delivery from his pen. The pursuit of science has not entirely failed, even in his case, to widen his mental scope, and render him wiser than his theological proclivities would alone have left him:

"Perhaps there is no part of the Bible in which the teaching of nature with reference to divine things is more fully represented than in the Book of Job, and I am inclined to think that not a few, even of religious men, fail to see precisely the significance of the address of the Almighty to Job, in the concluding chapter of that book. Job is tortured and brought near to death by severe bodily disease. His friends have exhausted all their divinity and philosophy upon him in the vain effort to convince him that he deserves this infliction for special and aggravated sins; at length the Almighty intervenes and gives the final decision. But instead of discussing the ethical and theological difficulties of the case, He enters into a sublime and poetical description of nature. He speaks of the heaven above, of the atmosphere, its vapors, and its storms, and of the habits and powers of animals. In short Job is treated to a lecture on natural history, yet this instantaneously affects what the arguments of his friends have altogether failed to produce, and Job humbles himself before God in contrition and repentance. * * *

"I would put this case of Job before modern Christians in three aspects: (1) Do we attach enough of importance to the Gospel of nature, as vindicating God's sovereignty and fatherhood, and preaching submission, humility and faith? Might we not here take a lesson from the Bible itself? (2) May there not be many in our time who like Job 'have heard of him with the hearing of

[1] "The So-called Conflict of Science and Religion." By Principal J. W. Dawson, of McGill University, in *The Science Monthly*, Vol x, pp. 72, 74.

the ear,' but have not seen him with the eye in his 'works,' and on the other hand, are there not many who have seen the works without seeing the Maker, who can even 'magnify God's works which men behold' without knowing the author of them? Would it not be well to bring more together in friendly discussion and comparison of notes, those who thus look on only one side of the shield? (3) Should we not beware of the error of Job's friends in misrepresenting God's plans and thereby denouncing those who differ from us? These three wise and well-meaning men had nature all around them, yet they disregarded its teachings, and dwelt on old saws and philosophic dogmas, until God himself had to bring out the whirlwind, the thunder-storm, the ostrich, the horse and the hippopotamus to teach a better theology." "What does this import? Simply that through the representation to him of God's works, Job had attained a new view of God and of himself. He had not considered or fairly viewed the world around him in its grandeur, its complexity, its unaccountable relations, and contrasted it with his own little sphere of thought and work."

So to the hitherto untaught, whether layman or divine, who, in ignorance of nature, have so generally "uttered what they understood not," "obscured counsel by words without knowledge," and have misrepresented God's plans, the philosophy of evolution will yet prove to be a revelation of the Divine wisdom.

Adhesion of Dr. McCosh.—The work of Dr. James McCosh, the distinguished professor of logic and mathematics of Queen's College, Belfast, on the "Divine Government, Physical and Moral," has been pronounced of preëminent merit, and even Dr. Charles Hodge, of Princeton, the accuser of Darwinism as rank atheism, asserts "it is generally regarded as one of the first books of the age." Dr. McCosh also wrote, in connection with Dr. Dickie, "Typical Forms and Special Ends in Creation," which is described as "in the modern phases of infidelity, as likely to prove more cogent than Butler and quite as unanswerable."

Dr. McCosh proved so powerful a champion against modern infidelity, so able a vindicator of the truths of revealed religion, that the College at Princeton, New Jersey, invited him to become its Principal. The directors were aware that there was no man among their divines of American theological training, competent to combat the "infidels" and do credit to their institution as a learned and accomplished president. Now what is the testimony of this distinguished teacher? It is that[1] "good may

[1] "Is the Development Hypothesis Sufficient?" by Dr. James McCosh in the *Popular Science Monthly*, Vol. x, pp. 86–100.

arise from showing that when the doctrine of development is properly explained and understood, and kept within its legitimate sphere, there is nothing in it inconsistent with natural or revealed religion." In his comments on Huxley's lectures he admits that[1] "transitional forms are ever casting up," and that "in certain fields we have these transitions already disclosed," that "certain cases indicate a tendency on the part of the reptile to rise to the bird, and of the bird to retain properties of the reptile. *I have ever stood up*," says he, "*for a doctrine of development.*" "I see nothing irreligious in holding that the bird may have been evolved by numerous transitions from the reptile, and the living horse from the old horse of the Eocene formation." "Let us suppose they can also, in rare cases of combination, produce species, religion is not thereby undermined either in its evidences or in its essential doctrine." "God is present in all His works, and acts in all their actings." "For in Him we live and move and have our being." "For we are also His offspring." "This doctrine may be so stated as to make it pantheistic. It is the one grand truth contained in pantheism, giving it all its plausibility, and making it superior to that *bald theism which makes God create the world at first, and then stand by and see it go.*" "This doctrine can be so stated as to free it from all such tendencies on the one side or the other, so as to make God distinct from all His works and yet acting in them. This is, I believe, the philosophical doctrine. It has been held by the greatest thinkers which our world has produced, such as Descartes, Leibnitz, Berkeley, Herschel, Faraday and multitudes of others." In the view of the renowned Jonathan Edwards, "nature is a perpetual creation." Dr. McCosh continues: "God is to be seen not only in creation at first, but in the continuance of all things. He is acknowledged not only in the origination of matter, but in its development, not only in the reptile and the bird, but in the steps by which the one has been derived from the other; not only in the Orohippus, but in the stages by which that animal has risen into the horse so useful to man." "I do believe that these old horse forms were preparations for the horse now living." Finally, we conclude our numerous extracts from the writings of Dr. McCosh, with the following: "Suppose we admit all that Huxley claims on this subject, what then? Have we set aside any doctrine of philosophy or religion?

[1] "Is the Development Hypothesis Sufficient?" by Dr. James McCosh, in the *Popular Science Monthly*, Vol. x, pp. 86–100.

God is still to be seen every where in His works, and rules over all. It appears to me," he adds, "that the whole doctrine of vegetable and animal species needs to be reviewed and readjusted, and religion need not fear for the result. I have been convinced of this ever since I learned, when I was ardently studying botany, that the number of species of plants had risen to two millions. I was sure that all these are works of God, but I was not sure that each was a special creation."[1] Thus it appears that Dr. McCosh, one of the ablest defenders of the Christian faith against the attacks of modern infidelity, is a pronounced evolutionist!

Adhesion of Rev. Charles Kingsley.—If the above from the able and orthodox Dr. McCosh does not suffice to show that the whole line of argument used by some popular anti-evolution critics is fitted only to delude the unwary, I may adduce the testimony of Rev. Charles Kingsley in my defense.

This eloquent divine and naturalist, in his "Westminster Sermons,"[2] and in a paper afterwards read to a meeting of London clergy at Sion College, remarks, "The God who satisfies our conscience ought more or less to satisfy our reason also. To teach that, was Butler's mission [in his 'Analogy of Religion, Natural and Revealed'], and he fulfilled it well. But it is a mission which has to be refulfilled again and again, as human thought changes and human science develops. For if in any age or country the God who seems to be revealed by nature seems also different from the God who is revealed by the then popular religion, then that God and the religion which tells of that God, will gradually cease to be believed in." "For the demands of reason must be, and ought to be, satisfied. And, therefore, when a popular war arises between the reason of any generation and its theology, then it behooves the ministers of religion to inquire, with all humility and godly fear, on whose side lies the fault? Whether the theology which they expound is all that it should be, or whether the reason of those who impugn it is all that it should be?" Kingsley pronouncing it the duty of the naturalist to find out the *how* of things, and of the natural theologian to find out the *why*, continues:

"But if it be said, 'After all there is no why, the doctrine of

[1] "Is the Development Hypothesis Sufficient," by Dr. James McCosh. The *Popular Science Monthly*, Vol. x, pp. 86–100.

[2] Charles Kingsley's "Westminster Sermons," quoted in "Darwiniana," pp. 281, 282.

evolution by doing away with the theory of creation does away with that of final causes,' let us boldly answer, 'Not in the least.' We might accept all that Mr. Darwin, all that Prof. Huxley, &c., have written, and yet preserve our natural theology on the same basis as that on which Butler and Paley left it. That we should have to develop it I do not deny. Let us look rather with calmness and even with hope and good-will on these new theories; they surely mark a tendency towards a more or less scriptural view of nature. Of old it was said of Him without whom nothing is made, 'My Father worketh hitherto, and I work.' Shall we quarrel with science if she should show how these words are true? What, in one word, should we have to say but this, 'We know of old that God was so wise that He could make all things, but behold, He is so much more than even that, that he can make all things make themselves.'"

Kingsley was wise in his generation. He well knew that theologians had always been worsted in their conflicts with science, and he would ward off the injury to religion that invariably follows the defeat of her teachers. Moreover, his acquaintance with natural science gave him an extraordinary advantage over such divines as Dr. Hodge, Herbert Morris, *et id omne genus.* Kingsley knew the force of the position taken by Prof. White, of Cornell University, in his "Warfare of Science," and the truth of which he has incontestably proved in that excellent and pithy work; that "In all modern history, interference with science in the supposed interest of religion, no matter how conscientious such interference may have been, has resulted in the direst evils, both to religion and science, *invariably.* And on the other hand all untrammeled scientific investigation, no matter how dangerous to religion some of its stages may have seemed for the time to be, has *invariably* resulted in the highest good of religion and of science."

Origin of Species.—The opponents of evolution sometimes quote a passage from Huxley, as follows, it is "my clear conviction that *as the evidence now stands,* it is not absolutely proven that a group of animals having all the characteristics exhibited by a species in nature, has ever been originated by selection whether artificial or natural." ("Lay Sermons," p. 295.) They evidently forget Huxley's demonstration of the evolution of the horse. "This demonstration does not admit of a doubt," says an excellent authority. Dr. McCosh, as already quoted, says "I do fully believe that those old horse forms were preparations for the

horse now living."[1] "The evidence is conclusive," says Huxley, "as far as the fact of evolution is concerned, and if it can be proved, as the facts certainly do prove, that a complicated animal like the horse may have arisen by a gradual modification of a lower and less specialized form, there is surely no reason to think that any other animals have risen in a different way. The case is not isolated. Every new investigation into the Tertiary mammalian fauna brings fresh evidence tending to show how the rhinoceros, the pigs, the ruminants, have come about. Similar light is being thrown on the origin of Carnivora, and also in a less degree, on that of all the other groups of animals. * * The accurate information obtained in this department [that is regarding the origin of species], has put the *fact* of evolution beyond a doubt. Formerly the great reproach to the theory was, that no support was lent to it by the geological history of living things; now whatever happens, the fact remains that the *hypothesis is founded on the firm basis of palæontological evidence*."—Huxley. Prof. Cope has shown us the origin of the camel by evolutionary processes with as much clearness and force as that of the horse has been demonstrated: Now the above has quite a different ring from Huxley's early admission!

But says the uninformed and persistent doubter, "We know nothing of the method by which these four-toed horses became three-toed, or the three-toed passed into the two-toed, and finally into the one-toed, as we find them in our day. You have brought no evidence to show that they have had any genealogical relation. There is no evidence in modern time to show that any such changes have taken place." Not so fast, my friend, we may reply. There is abundant evidence to show that changes are taking place of a very striking character, some of which are wonderfully pertinent to the case of the origin of the horse of our day. In the December number of the AMERICAN NATURALIST, p. 801, may be found the following, which should silence all discussion on this subject as final and conclusive.

Prof. Cope, when at the meeting of the California Academy of Sciences, Nov. 3, 1879, "Called attention to a pair of feet of a deer belonging to the academy, which were sent from Mendocino county, Cal. Each of these possessed but *one central toe* and

[1] Is the Development Hypothesis Sufficient? By Dr. James McCosh. In the *Popular Science Monthly*, Vol. x, pp. 86, 100.

hoof, instead of the usual *pair*. The speaker stated that the toes of the hinder feet were united throughout, and were so far developed beyond the usual point attained by the ordinary ruminant. The toes of the fore limb were different, *only* one being *continued to the hoof*, all the *others being rudimental*." The bones belonged to the modern deer and were not found fossilized.

But suppose the case rested on the evolution of the horse alone? When Newton demonstrated the law of gravitation from atoms to apples and falling towers, what did he do? He asserted *universal* gravitation! Men came to him with objections and difficulties, some trivial and some serious. He answered somewhat in this wise. "Gentlemen, some of your arguments are trivial, I would not answer them if I could; some are serious, just *now* I could not answer them if I would; nevertheless gravitation *is* and it is *universal*." All the objections to evolution may not be answerable at present, nevertheless the philosopher is justified in asserting that evolution *is* and that it *is universal*.

Evolution a Grand Generalization.—Some doubting critics esteems us "far too much inclined to accept as 'grand generalization' a bold and unproved theory and a theory which is hostile in its influences to the reception of the simple truths recorded for our profit in the Bible." What these simple truths may be they have not stated, and perhaps it were better they should refrain from the statement. I know of no more happy mode of turning the truths of evolution against the Bible, than that pursued by some perverse theologians of boldly asserting that they are antagonistic to the Scriptures. The truths of science, as we have seen in former discussions respecting geology, were regarded as antagonistic to the Bible, and anti-scientists were forced to admit the Bible in error or resort to the only avenue of escape, by considering it wrongly translated or improperly understood. Would it not be wise to admit this may again be the case, rather than provoke opposition and the damaging criticism of evolutionary science?

As respects the epithet "grand generalization," and the unproved character of the evolution doctrine, I have something more to say. Our critics have evidently not made themselves familiar with the profound philosophy of Herbert Spencer, who has based his wonderful works upon evolution, and is drawing therefrom his great system of scientific thought, the most original and most

important undertaking of the age. This system is solidly based upon the sciences of observation and induction, and is undoubtedly the largest scheme of systematic philosophy. Herbert Spencer is author of the only complete systematic statement of the doctrine of evolution. Now this Herbert Spencer is described by the most competent judges to be a thinker of larger calibre than has hitherto appeared in England, as keen an analyst as is known in the history of philosophy, not excepting Aristotle or Kant. In the highest realms of philosophical investigation he stands equal to all his predecessors, and has taken his position in the foremost rank of living thinkers. Now if a man of the character I have here outlined has taken evolution as a profound and all comprehensive generalization, we surely may be permited to accept it as such. Let us not, my good critic, resemble the ostrich that hides her head in the sand and imagines that because she does not see, therefore neither can the world around see.

Our critics add that evolution is not proved. Do they suppose that such a host of men, eminent in science, besides the honored name above given, would stultify themselves by admitting its truth and proclaiming it to be an invaluable boon, had they not convinced themselves of its inherent worth by bringing to its investigation all the lights at their command? Let us see what kind of minds entertain a firm belief that evolution has been proved to be a true philosophy. "It is Mr. Darwin's misfortune to know more about the question he has taken up than any other man living," says the learned Huxley.

Sir Charles Lyell, after having for fifty years studied the subject of life in connection with the past changes of the globe, and embodied all the older views in all his numerous works, at length in the tenth edition of his "Principles of Geology," *abandoned the old ground as untenable*, and adopted the views presented by Darwin.

Dr. Asa Gray stated before the Association for the Advancement of Science, that he had repeatedly attempted to catch Darwin tripping, and had had referred to him many cases which he himself at the time considered opposed to the theory, but in every case had *been forced* to withdraw his objections. Thomas Meehan made the same remark. He had often supposed Darwin in error, but had *always found him right.*

Dr. Fritz Müller, an eminent German naturalist, says he took

no small pains to detect contradictions among the inferences as to the class of Crustacea to which he had devoted himself, and found none furnished by Darwin's theory.

Dr. Gegenbaur, author of "Outlines of Comparative Anatomy," which has been adopted as an authoritative text-book, has re-cast his work and embodied therein the Darwinian philosophy. He regards comparative anatomy as the *touchstone* of the truth of evolution.

Darwin's name is always mentioned among the German naturalists with the profoundest reverence. His theory is now the common starting point of German science in many departments of knowledge that would seem at first to be farthest from natural history. The recent selection of Darwin as an associate of the French Academy of Science, the very highest honor that contemporary wisdom can confer, mark emphatically the esteem with which he is regarded in France, long unwilling to admit the value of his labors.

Whether evolution is to be recognized is then no longer an open question. "It is enough that it is a mental view that answers to a great reality, and is undoubtedly the broadest principle of unification in nature the human mind has yet reached." As to whether it *is proved*, depends upon the individual temperament and capacity of him who examines it. To some minds there exists no possibility of proving the truth or falsehood of any moral questions or of any physical problems, unless they can be brought to the test of mathematics. Minds of this character should confine themselves to their proper sphere, they are beyond instruction and are incorrigible. Evolution has been proved, as have many other problems in physical and natural science; the ablest experts are perfectly satisfied, why should the popular mind withhold its assent? "I do not think that I am speaking too strongly when I say that there is now scarcely a single competent general naturalist who is not prepared to accept some form of the doctrine of evolution," says Prof. C. Wyville Thomson in his Introduction to "The Depths of the Sea," an account of the general results of the dredging cruise of the *Porcupine* and *Lightning*, 1868, 1869 and 1870, p. 9.

It may interest our readers to know to what extent the doctrines of evolution are taught in our higher institutions of learning. At Harvard every professor whose departments are connected with

biology, such as Gray, Whitney, A. Agassiz, Hagen, Goodale, Shaler, James, Farlow and Faxon, is an evolutionist, and man's physical structure they regard as no real exception to the law. They are all said to be theists and all conservative men. At Johns Hopkins University, Baltimore, which aims to be the most advanced in the country, evolution is held and taught. In the University of Pennsylvania all the biological professors are evolutionists, Leidy, Allen, Rothrock and Parker. At Yale, Michigan University, Brown, Cornell, Dartmouth, Bowdoin, Princeton, the biological professors are all in the same category. There can scarcely an exception be found. Wherever there is a working naturalist he is sure to be, almost without an exception, an evolutionist. Prof. James D. Dana often adduced as an opponent, in his new "Text Book of Geology," p. 341, says: "Its progress [the system of nature] if by divine power should be, as zoölogical history attests, a development, an unfolding, an evolution." "We challenge," says an ex-president of the American association for the advancement of Science, "to find three working naturalists of repute in the United States—or two (we can find one in Canada)—that is not an evolutionist. I should regard a teacher of science who denied the truth of evolution as being as incompetent as one who doubted the Copernican theory." (*Popular Science Monthly*, Vol. XVI, pp. 558–559.) "It is now regarded, among the active workers in science, as a waste of time to discuss the truth of evolution. The battle on this point has been fought and won."

Evolution demonstrated by the Changes going on around us.—Those of our critical friends to whom evolution is not to their understandings established on a basis of demonstration, I would refer to a very instructive paper republished in the supplement to the *Popular Science Monthly*, Vol. XV, entitled "Animals and their Environments." They will there find indubitable proof that certain animals were not originally created as they now exist, and that their surroundings have greatly modified their forms, and the doctrine of special creation demolished. Among others, the changes that take place in the flounder and other flat fishes are described, and the manner in which these fishes, originally formed symmetrically like others of their congeners, with eyes on both sides of their heads, swimming upright, and colored on the back and white on their under side, become, through want of a swimming bladder to preserve them in an upright position obliged

to turn upon their sides and to descend to the bottom of the water. Here they undergo a metamorphosis, which is a wonderful instance of the manner in which nature modifies animals and adapts them to new conditions. The flounder thus placed at the mercy of its environment, begins to change color on the under side which becomes whiter from the absence of light, while the upper side becomes darker from its continuous action. The eyes were originally on opposite sides of the head, as in normal fishes, but the eye which was created upon the side which is now undermost, gradually moves around and takes its place upon the upper side, thus presenting the appearance, familiar to any one who has seen the turbot or flounder, of an animal with both eyes on the same side of its head.

They will there find, also, a notice of the transformation of the North American axolotl (Siredon) into a completely different animal, with which it was not known to have near relationship, and already placed in a different genus. They will also see an explanation of the manner in which the Alpine salamander has probably changed from an egg-bearing to an ovo-viviparous animal in places too dry for the production of animals having gills in their earlier stages, by causing the eggs to hatch within the mother, and the young to pass their gill stage within the fluids of her body instead of in water, as do the young of other newts or salamanders.

There is an excellent lesson in evolution to be found in the history of the Sacculina, which is a parasite upon the hermit crab. This illustrates the manner in which *degradation* is brought about, for this is often as striking a process of evolution as is *advancement* to higher forms. This Sacculina, as it is found on hermit crabs, is a sort of cylindrical mass with a bundle of roots growing from one side; sense it has none, limbs none, organs none, and hardly the vestige of organs and only the faintest traces of mouth and intestines. It is an embryo but not far enough advanced to show what it is to be. Listen to its history. This structureless lump began life as a little barnacle crab, swimming in the ocean, having a symmetrical body, three pairs of legs and one eye, and bearing a close resemblance to the embryos of all crabs in this state, which is called the "nauplius stage," or that first to develop out of the egg. Very soon our nauplius barnacle leaves off roving and attaches himself to the soft hind parts of a

relative, the hermit crab, and begins to suck the juices of his host. He soon loses his eye, then his limbs, then the segmentation of his body, then his head, his intestines, his everything that seems to constitute him an animal. He grows too lazy and sinks too low even to eat. Around his mouth develop a bundle of roots which spread through the soft body of the hermit crab as roots of a plant through the ground, and he sinks to the level of a mere automatic existence. Now his host, the hermit crab, and this degraded Sacculina started alike, and in the long ages, before the hermit had come to be what he is, the common ancestor of all crabs, wore, in maturity, the form of this parasite in its nauplius stage. Parasitism has pulled the Sacculina down to utter debasement, as it has all other parasites whether in man or animals. Thus creation advances and recedes, and numberless instances of both processes could be found in nature, for description of some of which I would refer to "Life History of our Planet," by Wm. D. Gunning, and "The History of Creation," by Ernst Haeckel.

The above instances of actual transformation among hundreds that could be adduced, the result of their surroundings, changes brought about by changed conditions, must give our critics reason to pause before they again attempt to deny that Darwinism can bring to its defence the "hard logic of facts" and sound induction.

We have occasionally heard the remark, that it is degrading to the self-respect of man to consider himself descended from a long line of animals, beginning with the polyp or ascidian. Let us consider that in evolution we have no *new truth*, but an old truth in a new form, the evolution of the individual by a slow process from a microscopic germ. Everybody knows that this is the process of development through which every one of us has passed. Yet it has never interfered with our belief in an intelligent Creator. When asked who made us, we say "God made us." But how were we made? The only true answer must be, by a process of evolution, a slow process of evolution from a microscopic sphere of unorganized protoplasm, the germ cell. This knowledge does not lessen our respect for the dignity of man, why then should it be different in the case of the origin of our species and of all species by evolution.[1]

[1] The earnest reader who desires to become acquainted with the most advanced views of students of biology, and the recent demonstrations of the stages through

The Struggle for the Liberty of Science.—To those who are acquainted with the history of physical discovery, and the great struggle for the liberty of science, the conflict waged with evolution by theological error seems but a continuation of the struggle that has lasted for so many centuries. "Unfortunately, some good men started, centuries ago, with the idea that purely scientific investigation is unsafe, that theology must intervene, and thus began this great war." Among the leading innovations advanced by science, there are few indeed that have not been opposed by theologians. The idea that the earth is a globe was pronounced fraught with danger to Scripture—that is the *popular interpretation*—and the great majority of the fathers of the church denied that a man could be saved who believed the earth to be round and inhabited on its opposite sides! It was not until Magalhaens sailed around the earth, that theologians subsided. The Copernican theory of the heavens, now universally accepted, was solemnly condemned, and to read the book of Copernicus was to risk damnation. H. Bruno was hunted from land to land and finally burned alive because of its advocacy. It was not established until the telescope of Galileo confirmed its truth, and even then, many either declared it impious to look into the telescope of Galileo, or if they saw the satellites of Jupiter, denounced them as delusions of the devil! The story of the unfortunate Galileo, and his sorry recantation of the truth, is known to all intelligent readers.

"There has been raised the same cry in all ages—the same we hear in this age—for curbing scientific studies." The anatomist Vesalius was hunted to death because he dissected the human body. Theology denounced in sermons "the dangerous and sinful practice of inoculation" for the small-pox, and Jenner's vaccination was declared as "bidding Heaven defiance." Even the use of chloroform in our own day, for theologians have not learned wisdom, was, from the pulpit, declared "contrary to Holy Writ!"

which the genesis of man has been effected, should consult a series of papers published in the *Penn Monthly* for April, May and June, 1877, and since re-published by E. Stern & Co., 125 and 127 N. Seventh street, Philadelphia. These papers, by L. A. Ward, A.M., are entitled "Haeckel's Genesis of Man; a History of the Development of the Human Race," being a review of his Anthropogenie, embracing a summary and exposition of his views and of those of the advanced German school of science, and since translated into English and published, and entitled "The Evolution of Man," by that vigorous expositor of this doctrine. New York, 1879.

It is difficult to realize that within our own memory a similar battle raged between the advocates of what was called the "sacred theory of the earth" and the views of geologists, and that anathema, styled arguments, were used in the nineteenth century similar to those hurled at science in the middle ages. In our own day geology has been declared "not a subject of lawful inquiry," and denounced as a "dark art, dangerous and disreputable," as "infernal artillery," and as "an awful evasion of the testimony of revelation."[1]

There have been many other battle fields, equally instructive, in which theologians have opposed the progress of the age and blindly fought against the good of mankind. Fanning mills were at one time denounced as contrary to the text, "the wind bloweth where it listeth" and as leaguing with Satan, who is "the prince of the powers of the air," and as sufficient cause for excommunication from the Scotch church.[2] The railroad and the telegraph have been denounced from a noted pulpit as "heralds of Anti-Christ!!"

But perhaps the most ridiculous proposal to prove that "it is supreme folly to talk of accommodating Christianity to Darwinism," is that announced in the *Church Journal*, by a reviewer of Dr. Hodge's book against Darwinism, which is as follows: "If we have all, men and monkeys, women and baboons, oysters and eagles, all 'developed' from an original monad and germ, then St. Paul's grand deliverance, 'All flesh is not the same flesh. There is one kind of flesh of men, another of beasts, another of fishes and another of birds; there are bodies celestial and bodies terrestrial'—may be still very grand in our funeral service but very untrue to fact." Oh sad! sad! that any man supposed to be sane could give forth such an utterance as argument! What good can possibly result to mankind from the opposition of ignorant men who stand upon high places "screaming in wrath at the advance of science." In every case this ecclesiastical war, during its continuance, has tended to drive multitudes of thoughtful men away from religion, and theologians have to answer for this result.

In all this long warfare the victory has invariably been with science, and "the whole civilized world now declares that it was

[1] See "Geology and Scripture," by Pye Smith, D.D., pp. 156, 157, 168, 169.
[2] "Bartons' History of Scotland," Vol. viii, p. 511.

won for religion—that thereby was infinitely increased the knowledge of the power and goodness of God." "Let then the warfare of science be changed," says Prof. A. D. White, from whom we have derived several of our illustrations. "Let it be a warfare in which religion and science shall stand together as allies. Let the fight be for truth of every kind, against falsehood of every kind, for the living kernel of religion rather than the dead husks of sect and dogma, and the great powers whose warfare has brought so many sufferings, shall at last join in ministering through earth, God's richest blessings."[1]

Conclusion.—Want of a scientific habit of mind is the source of much of the prevalent misconception as to what constitutes adequate proof in natural science.

In order to understand the doctrine of descent, or the theory of evolution, it is indispensable that the inquirer possess a general knowledge of biological phenomena. It must be evident that a certain degree of general culture, and especially a philosophical education, is requisite to enable one to comprehend the individual and palæontological history of development. This preparation unfortunately many persons in our day do not consider at all necessary. "One hears hundreds of half educated persons pass a final judgment upon it, although they acknowledge that they know nothing either of botany or of zoölogy, of comparative anatomy, of palæontology or of embryology." Hence it happens, as Huxley well says, that "most writings published against Darwin are not worth the paper upon which they are written."—Quoted by Haeckel in his "History of Creation," Vol. II, p. 346.

Among many recent opinions expressive of approval of the doctrines of evolution, the following may properly conclude this article.

Prof. Stanley Jevons, one of the clearest thinkers of our day, and the master spirit who has proved that John Stuart Mill's great work on "Logic" is essentially illogical, admits that Herbert Spencer has made a new epoch in philosophic thought. When speaking of Spencer's "Data of Ethics," which is the culmination of his philosophy, Prof. Jevons asserts that "Spencer has pointed out that the universe is one deep-laid framework for

[1] "The Warfare of Science," by Andrew Dickson White, LL.D, President of Cornell University. N. Y., Appleton & Co., 1877. Pages 150, 151.

the production of beneficent contrivances," and that it "is a deep-built scheme working towards goodness and happiness." "Spencer calls upon us to admit the inventing machine of evolution, a 'machine' which is the most comprehensive of all machines, because it is ever engaged in inventing beneficial inventions *ad infinitum.*" "We must accept the philosophy," says Jevons, "if it be true, and for my part I do so without reluctance." "According to Spencer," continues this admirable critic, "we are the latest manifestation of an all-prevailing tendency towards the good, the happy, and that we are no lump of protoplasm but the creature of a Creator."—*Contemporary Review*, Nov., 1879. Let it be remembered that as the sagacious Dr. McCosh expresses it, "Herbert Spencer is to a large extent the author and is certainly the organizer and the embodiment, personification and expression of development."—*Princeton Review.* "Theologians have ever been free in the application of damnatory expletives to scientific ideas which do not conform to their standard," but it is very pleasant to turn from denunciation and anathema to the language of *The Nonconformist* of November 5th, a journal of the English orthodox dissenters, and there read the following opinion of Spencer's "Data of Ethics," his last production, and the culmination of his system of philosophy. Speaking of the glimpses it affords into the future which its author anticipates, *The Nonconformist* remarks, "No loftier view, we venture to say, was ever entertained." "The optimism of Mr. Herbert Spencer is as pure as that of the most spiritual seers of the past, and it involves as radical a change in human nature as that demanded by the New Testament. It is, in his own words, 'a rationalized version of its ethical principles.' The fact that they are Christian in their essence is rather a hindrance to their acceptance, since conventional Christianity practically repudiates the ideal morality of its founder."

We never expected to live to see the name of Herbert Spencer, the embodiment, personification and expression of development "received with applause in a great religious convention of orthodox people, but if the report of the London *Times* of October 10th can be trusted, this extraordinary phenomenon has actually occurred! In that convention the Rev. Prof. Pritchard gave an eloquent and powerful address on "The Religious Benefits from Recent Scientific Research," in which the doctrine of evolution

was assumed as true, and as in entire harmony with all essential religious truth. He was followed by the Rev. Prof. Watkins, of St. Augustine College, Canterbury, who spoke on the same subject, and said " he felt sure that when the history of the century came to be written from the standpoint of the future, the name of Herbert Spencer would be found in the very first rank of English thinkers." "These expressions indicate a very marked progress in religious liberality," says the editor of the *Popular Science Review* of January, 1880.

Prof. James D. Dana in his new "Text Book of Geology," p. 346, expresses his opinion on this wise: "That the system of life exhibits so perfect harmony and so complete oneness of law in its several lines and successions, that it may be truly called a system of development or evolution, whatever the method by which it was carried forward," and that, " It is also certain that science, whatever it may accomplish in the discovery of causes or methods of progress, can take no steps toward setting aside a Creator. Far from such a result, it clearly proves that there has been not only an omnipotent hand to create and to sustain physical forces in action, but an all-wise and beneficent Spirit to shape all events towards a spiritual end."—Ibid, p. 351.

Thus it is easily shown that the opinions of men disqualified by age or a conservative spirit, interested prejudice or enfeebled faculties, should not be regarded when opposed to new doctrines in science; that those who have devoted themselves to science have, whenever free from the prejudices of education, heartily embraced the new views; and finally that even those who have been regarded as the ablest defenders of the truths of revelation when enlightened by acquaintance with science and penetrated by its spirit, become generous defenders and fearless advocates of evolution and absolve it from all charges of atheism and want of scientific basis.

THE SUPPOSED DIMORPHISM OF LITHOSPERMUM LONGIFLORUM.

(*L. ANGUSTIFOLIUM* MICHX. OF GRAY'S SYNOPTICAL FLORA.)

BY PROF. C. E. BESSEY, M.SC., PH.D.

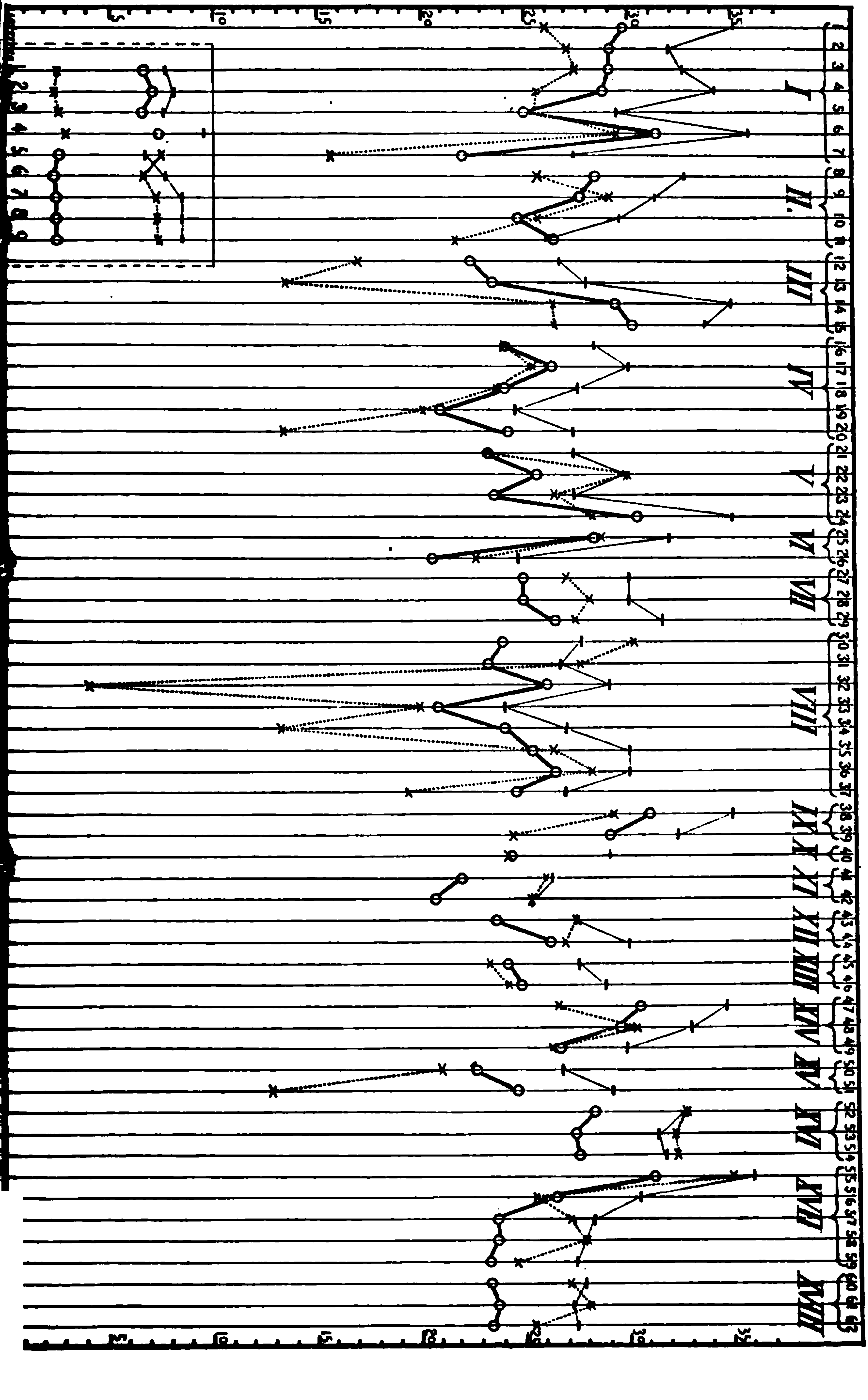
THE plant under consideration is a common herbaceous perennial of the prairies and great plains of North America. In the latter part of April and during the month of May it produces flowers with bright yellow salver-shaped (*hypocraterimorphous*) corollas, whose tubes are about thirty mm. (one and one-fifth inch) long, and from two to three mm. in diameter. About the first of June, in Central Iowa, these large flowers suddenly disappear, and from this time forward until the autumn frosts, they produce only small cleistogamous flowers.[1] The corolla lobes of the latter cohere somewhat, and remain closed, and in this condition the total length of the corolla is from five to seven mm., the tube itself being no more than three to five mm. long. Both kinds of flowers produce seeds, and I have not observed any difference in their relative fertility, although there are actually at least ten times as many seeds produced during the season by the small flowers as by the large ones, for the reason, however, that there are many more of the former flowers than of the latter. Of the small flowers I will have somewhat to say at another time; what I wish particularly to notice at this time is the relative position of stamens and stigma in the large early flowers.

An examination of a number of flowers shows that in some the anthers are higher than the stigma, while in others they are lower, and unless careful measurements are made, one is led to consider this as a case of dimorphism of the sexual organs (the heterogonous dimorphism of Dr. Gray, and heterostyly of Hildebrand, Darwin and others), a supposition which is rendered still more probable by the well-marked dimorphism of the flowers of the nearly allied *Lithospermum canescens* Lehm. However, after making a large number of very careful measurements, I have no hesitation in saying that in the plants as they occur in Central Iowa there is no dimorphism whatever, but that we have here a case of great and irregular variability in the length of the style and of the corolla tube, and that upon the varying length of the latter depends the varying position of the stamens.

In the following table the flowers of the first ten plants were measured May 4, 1878; those of the next five, May 19, 1877; and those of the remaining three, May 26, 1877.

[1] First noticed by M. S. Bebb. See AMERICAN NATURALIST, Vol. VII, p. 691.

Plant Numbers.	Flower Nos.	Length of Corolla Tube.	Height of Anthers.	Height of Stigma.
Plant No. 1..................	1	35.0 mm.	29.8 mm.	26.0 mm.
"	2	31.8 "	29.0 "	27.0 "
"	3	32.5 "	29.0 "	27.4 "
"	4	34.0 "	28.6 "	25.4 "
"	5	29.3 "	25.0 "	25.4 "
"	6	35.7 "	31.2 "	29.4 "
"	7	27.3 "	22.0 "	15.8 "
Plant No. 2..................	8	32.8 "	28.4 "	25.7 "
"	9	31.3 "	27.8 "	29.0 "
"	10	29.6 "	24.8 "	25.8 "
"	11	26.0 "	26.3 "	21.8 "
Plant No. 3..................	12	26.8 "	22.7 "	17.0 "
"	13	28.0 "	23.7 "	13.2 "
"	14	35.0 "	29.4 "	26.3 "
"	15	33.8 "	30.2 "	26.4 "
Plant No. 4..................	16	28.2 "	24.0 "	24.0 "
"	17	30.0 "	26.2 "	25.4 "
"	18	27.6 "	24.0 "	23.7 "
"	19	24.5 "	21.0 "	20.0 "
"	20	27.4 "	24.2 "	13.2 "
Plant No. 5..................	21	27.4 "	23.2 "	23.2 "
"	22	30.0 "	25.8 "	30.0 "
"	23	27.4 "	23.6 "	26.4 "
"	24	35.0 "	30.4 "	28.2 "
Plant No. 6..................	25	32.0 "	28.2 "	28.4 "
"	26	24.8 "	20.8 "	22.6 "
Plant No. 7..................	27	30.0 "	25.0 "	27.0 "
"	28	30.0 "	25.0 "	28.0 "
"	29	31.6 "	26.4 "	27.2 "
Plant No. 8..................	30	27.8 "	24.0 "	30.3 "
"	31	26.8 "	23.3 "	27.8 "
"	32	29.0 "	26.0 "	4.0 "
"	33	24.4 "	21.0 "	20.0 "
"	34	27.0 "	24.0 "	13.4 "
"	35	30.0 "	25.4 "	26.4 "
"	36	30.0 "	26.5 "	28.3 "
"	37	27.0 "	24.8 "	19.4 "
Plant No. 9..................	38	35.0 "	31.0 "	29.2 "
"	39	32.4 "	29.0 "	24.4 "
Plant No. 10..................	40	29.0 "	24.4 "	24.2 "
Plant No. 11..................	41	26.4 "	22.0 "	26.0 "
"	42	25.4 "	20.8 "	25.4 "
Plant No. 12..................	43	27.4 "	23.6 "	27.4 "
"	44	29.9 "	26.1 "	26.9 "
Plant No. 13..................	45	27.6 "	24.1 "	23.3 "
"	46	28.9 "	24.8 "	24.1 "
Plant No. 14..................	47	34.7 "	30.4 "	26.6 "
"	48	33.0 "	29.7 "	30.2 "
"	49	29.9 "	26.6 "	26.1 "
Plant No. 15..................	50	26.9 "	22.8 "	21.0 "
"	51	29.2 "	24.6 "	12.9 "
Plant No. 16..................	52	32.7 "	28.2 "	32.7 "
"	53	31.4 "	27.4 "	32.2 "
"	54	31.7 "	27.4 "	32.2 "
Plant No. 17..................	55	36.0 "	31.2 "	35.0 "
"	56	30.4 "	26.4 "	25.6 "
"	57	28.2 "	23.6 "	27.1 "
"	58	27.9 "	23.6 "	27.9 "
"	59	27.4 "	23.3 "	24.6 "
Plant No. 18..................	60	27.9 "	27.1 "	23.6 "
"	61	27.1 "	28.2 "	23.8 "
"	62	27.4 "	23.3 "	25.4 "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These measurements are more readily compared when presented in a diagrammatic form (see Plate). In this the length of the corolla tubes is indicated by the length of the vertical line measured from the bottom line to the mark –, the height of the anther by o, and of the stigma by ×. For greater distinctness the similar points in all the flowers of each plant are connected by lines; the fine line thus indicates the variation in length of corolla tubes, the heavy one of the position of the anthers, and the dotted one, of the stigmas. The scale is magnified three times.

The remarkably short style of flower No. 32, bore a distinctly two-lobed stigma, which under a lens was seen to be papillated. I think it was functional. In the case of flower No. 51, there is some doubt as to whether or not the stigma was functional; the shortness of the style may have been due to injury. In all other cases there were no reasons for supposing the stigmas functionless.

As it is well known that in cases of heterogonous dimorphism the pollen grains of the two forms differ in size, I made many careful measurements of the pollen of flowers from seven different plants, and found considerable variation in size. The grains when dry are considerably elongated, being prolate-spheroidal in shape, but when wet they swell up and become spherical. The following measurements show the variations:

Flowers	1 to 7, pollen dry, prolate-spheroidal....	.025 × .035 mm.
"	15, pollen dry, prolate-spheroidal.......	.025 × .035 "
"	16 to 20, pollen dry, prolate-spheroidal...	.025 × .035 "
"	21, pollen wet, spheroidal..............	.035 "
"	22, pollen dry, prolate-spheroidal........	.025 × .035 "
"	23, pollen wet, spheroidal..............	.035 "
"	52, pollen wet, spheroidal..............	.042 "
"	53, pollen wet, spheroidal..............	.039 "
"	54, pollen wet, spheroidal..............	.038 "
"	55 to 59, pollen wet, spheroidal.........	.039 "
"	60 to 61, pollen wet, spheroidal.........	.039 "
"	62, pollen wet, spheroidal..............	.042 "

It will be difficult to see, in these measurements, any evidence of dimorphism as to the pollen grains. It may be interesting to note here that the spherical pollen grains of the cleistogamous flowers have a diameter of only .025 to .027 mm.

If now we compare the foregoing measurements with **similar**

ones of *Lithospermum canescens* Lehm., we may see how far *L. longiflorum* is from showing dimorphism:

Plant Nos.	Flower Nos.	Length of Corolla Tube.	Height of Anthers.	Height of Stigma.	Pollen.
Plant No. 1	1	7.8 mm.	6.8 mm.	2.8 mm.	Pollen grains ovoidal, slightly constricted in the middle. .019 × .03 mm.
"	2	8.1 "	7.1 "	2.5 "	
"	3	7.6 "	6.6 "	2.8 "	
Plant No. 2	4	9.6 "	7.3 "	3.0 "	
Plant No. 3	5	6.8 "	2.8 "	7.6 "	Pollen grains oblong, much constricted in the middle. .01 × .019 mm.
"	6	7.8 "	2.5 "	6.8 "	
"	7	8.6 "	2.7 "	7.3 "	
"	8	8.6 "	2.7 "	7.3 "	
"	9	8.6 "	2.7 "	7.3 "	

These measurements are entered upon the diagram (Plate) at the lower left hand corner, upon the same scale as those of *L. longiflorum.*

The following facts are clearly shown above in the case of *L. longiflorum:*

1st. The length of the corolla is exceedingly variable.

2d. The distance from the anthers to the top of the corolla tube is approximately uniform, so that the position of the anthers is largely dependent upon the length of the corolla tube.

3d. The length of the style is even more variable than that of the corolla tube.

Have we here a case of incipient heterostyly; or has this species but recently (since falling into cleistogamy) abandoned its former heterostylous form and habits? Probably there is some connection between the cleistogamy of the later flowers and the irregularity of the earlier ones.

——:o:——

NOTICE OF SOME AQUATIC WORMS OF THE FAMILY NAIDES.

BY PROF. JOSEPH LEIDY.

THE little worms of the family of Naides, comprising the genera Nais, Pristina, Stylaria, Dero, Æolosoma, Aulophorus, Chætogaster, etc., are common in ponds, ditches and other quiet waters, mostly living among various aquatic plants, or in the superficial sediment. They have always been viewed with special interest from their conspicuously exhibiting the process of multiplication through division, often being seen in a string of

from two to four individuals together. From the want, in many cases, of sufficiently complete descriptions and accurate representations of the European forms, there is more or less uncertainty how far ours may agree with or differ from them.

Among our Naides I have observed several species pertaining to or nearly allied with the singular genus Dero. One of these, formerly described under the name of *Dero limosa* (Proc. Acad. Nat. Sci., 1857, 226), appears to accord so closely with the European species, *Dero digitatà* of Oken, that better means of comparison may prove it to be the same. The latter, originally described and figured by Müller upwards of a century ago, "as the blind Naiad"—"*die blinde Naide*" (Von Würmen, Kopenhagen, 1771, 90, 95, Tab. v, Fig. 1–3) is represented with the body of the worm ending in a broad funnel-like pavilion opening obliquely upward and furnished with four pairs of divergent rays, successively increasing in length from before backward. Another European species, described by Udekem as *Dero obtusa*, is represented with two pairs of rays to the caudal pavilion (Bul. Acad. Sci. Belgique, 1855, 549; Mem. Acad., 1859, 18), and is likewise so described by Perrier (Archiv. Zool. Exp., Paris, 1872, 65). Semper has more recently described two species, *Dero rodriguezii* and *D. philippinensis*, which differ from the preceding and each other in the character of the caudal pavilion (Arbeit. Zool. Inst., Wurzburg, 1877, 106, 107).

Dero limosa is frequent, and is to be found creeping among aquatic plants or on the sides of the vessel containing the water in which they have been collected, or it may be observed partly buried in sediment, projecting from a short chimney of its own construction, rising above the surface of the sediment, and with the caudal pavilion expanded.

The characters of the worm are as follows: Body compressed cylindrical, transparent, with red blood. In an individual of a fourth of an inch in length, without signs of division, there were forty-eight rings, or body segments, of which about a dozen posteriorly became successively more and more rudimental in the disappearance of the podal stylets and bristles. In specimens exhibiting evidence of division into a series of from two to four individuals, measuring up to half an inch in length, and stretching even to three-fourths of an inch or more, the number of rings together did not appear to be greater, and sometimes was

less, ranging from forty-two to forty-eight. Head ovoid, with the upper lip conical and more or less angular and obtuse. Eyeless. Caudal ring expanding into a broad, membranous, funnel-like pavilion, opening in a slanting manner dorsally and supporting eight divergent rays (see Fig. 1); anterior pair of rays papilliform; the others digitiform and successively increasing in length to the last pair. The rays are capable of extension beyond and retraction within the border of the pavilion, and this is also retractile, and when closed in the lateral view looks like the keeled prow of a boat. When the caudal pavilion is expanded, active ciliary motion is observed extending along the rays inwardly to the rectum, which motion most probably subserves a respiratory purpose.

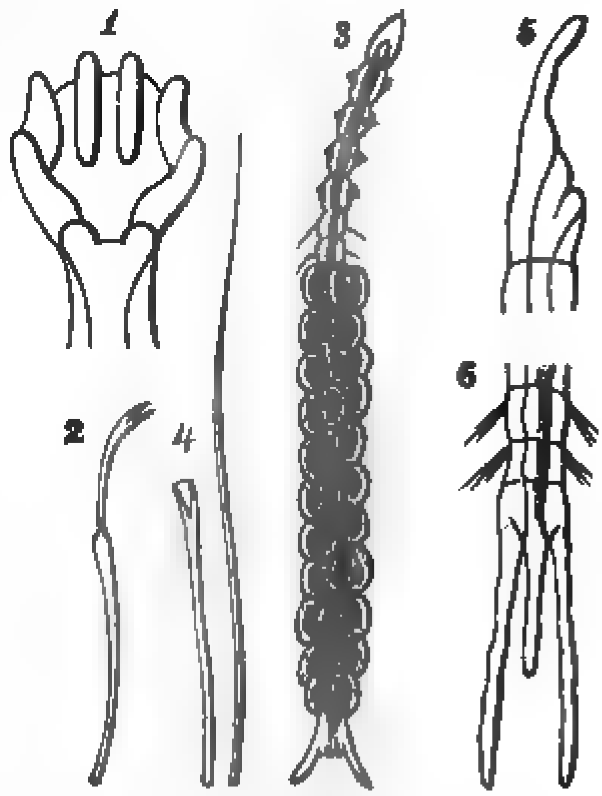

FIG. 1.—Caudal pavilion, with the rays not fully extended, of *Dero limosa*, viewed from above. FIG. 2.—A podal stylet. FIG. 3.—*Aulophorus vagus* within a tube composed of Plumatella statoblasts, magnified about six diameters. FIG. 4.—Spade-like podal stylet and bristle. FIG. 5.—Side view of the head of *Pristina flagellum*. FIG. 6.—Posterior extremity of the body of the same with its three caudal appendages.

The anterior four rings of the body are provided on each side with fascicles of four or five podal stylets, and the succeeding rings with fascicles of three or four stylets. The latter rings are also provided more dorsally on each side with additional fascicles mostly of a single stylet and a simple bristle. Stylets sigmoid with a median shoulder, and ending in a furcate hook (see Fig. 2).

Another of the little worms allied to the genus Dero, was collected together with some Plumatella scraped from a log in a ditch of the meadows below Philadelphia. It was in the latter part of September, and the water collected contained a great many detached statoblasts or winter eggs of the Plumatella. The worm first attracted my notice from the fact that it occupied a tube composed of the Plumatella eggs cemented together, and which it dragged about in the same manner as the larva of the Caddis does its case (see Fig. 3). The only worm of European wat

appears to approximate this one, and which may prove to be the same, was described and figured a century and a quarter ago by the portrait painter naturalist, Rõsel von Rosenhof, as the little supple water-serpent with two fork prongs—"*das geschmeidige Wasserschlänglein mit zwey Gabelspitzen*" (Insecten Belustigung, Nürnberg, 1755, Th. 3, 581, Tab. XCIII, Fig. 8–16). In character and habits it so closely accords with the genus Aulophorus of Schmarda (Neue wirbellose Thiere, 1861, II, 9), that I have referred it to a species of the same. Schmarda describes two species, *A. discocephalus* of Jamaica, and *A. oxycephalus* of Ceylon.

Our species I propose to name *Aulophorus vagus.* Its characters are as follow: Body compressed cylindrical, transparent, with red blood and yellowish-brown intestine. Single individuals of the third of an inch or more in length, composed of twenty-four to thirty-five rings. Head ovoid, extending as a conical upper lip, very mobile and changeable in form, obtuse or sub-acute, and minutely hirsute. Eyeless. Caudal ring contracted and furnished with a pair of long divergent digit-like appendages, which are straight or slightly incurved, blunt and minutely hirsute. Anal aperture surrounded by a rosette of half a dozen prominent, blunt, conical papillæ. The four rings succeeding the head furnished on each side with fascicles of seven to nine podal stylets; the succeeding rings, except the last, with fascicles of five to six podal stylets, which are shorter than the former. Podal stylets sigmoid, with a median shoulder, and ending in a furcate hook (Fig. 2). The same posterior rings furnished dorso-laterally with fascicles consisting each of usually a single moderately long bristle, and a single, nearly straight stylet, ending in a spade-like expansion (see Fig. 4).

Pharynx capacious, extending into the fifth ring, and narrowing into an œsophagus which ends in the intestine within the ninth ring. Generative organs unobserved. Worm of three to five lines in length, or more, according to its degree of extension. Living in a tube of its own construction which it drags about with it. The tube is composed of a transparent cement or basis incorporated with various materials, such as vegetal particles, sand, dirt, diatoms, spongilla spicules, etc. In creeping about among aquatic plants, Lemna and Wolffia, the worm stretches in such a manner that one-third of the body extends from the fore part of the tube, while the forked caudal extremity remains projected

from the back end. The worm moves in jerks, alternately extending the fore part of the body and projecting the podal fascicles forward and hooking into the surface on which it is creeping, and then contracting the fore part of the body and dragging along the back part enclosed within the tube. Frequently the motion is aided by the eversion of the pharynx, so as to form a disk or sucker which adheres to surfaces, like that of a leech. The movements occur in quick succession, so that the worm creeps about quite actively. At times the worm will double on itself and in this way pass through its tube and reverse its direction. At times too it will leave its tube and creep about without one. The papillæ of the anal aperture are clothed with vibratile cils, which produce an active current inwardly as observed in Dero.

Another little Naiad with conspicuous caudal appendages, in all other respects except in the possession of the latter, resembles Pristina, and I have therefore regarded it as such, with the name of *Pristina flagellum.* Its characters are as follow: Body compressed cylindroid, transparent, with red blood. In a specimen one-fourth of an inch long and exhibiting evidence of division into two individuals, there were about sixty rings, or thirty to each division. Head conical and prolonged into a digit-like upper lip (Fig. 5). Eyeless. Caudal ring furnished with three long digit-like, blunt appendages, trailing behind; the lateral pair nearly twice the length of the intermediate one (Fig. 6). Podal stylets in fascicles of four, on each side ventrally, to all the rings except the terminal ones; sigmoid with a median shoulder and ending in a furcate hook. Bristles to all the rings dorso-laterally, except the terminal ones, in fascicles of three to six.

Length of worm, 6 to 7 mm.; breadth 0.3 mm.; length of digit-like upper lip from the mouth, 0.25 mm.; length of lateral caudal appendages, 0.75 mm.; of intermediate one, 0.375 mm.; length of bristles, 0.25 to 0.375 mm. Creeping among aquatic plants in the ponds of sphagnous swamps, New Jersey and Pennsylvania.

AMERICAN WORK IN THE DEPARTMENT OF RECENT MOLLUSCA DURING THE YEAR 1879.

BY WILLIAM H. DALL.

IT has not been practicable for the writer to emulate the *Zoölogical Record* in minuteness of detail, however desirable that course might have been for some reasons. It is possible that some minor papers may have been overlooked from not having been sent to the Smithsonian Institution or the writer during the year, but it is not likely that anything of importance has escaped notice. It was open to the writer to make this article a mere catalogue or a review of work done. He has chosen the latter as the most useful course, and has freely expressed his opinions in regard to the papers enumerated. It is a subject for regret that, in America, among those who are interested in Mollusca especially, the veterans are passing away and few come to fill their places. This is perhaps due to the absence of any satisfactory text book, the condition of the nomenclature and the inferior position occupied by the groups in most manuals of zoölogy, so far as treatment is concerned. We may hope that the laboratories of Prof. Alexander Agassiz and of the Johns Hopkins University, with the other seaside summer schools, may produce good fruit in this direction. There is certainly no department as a whole in which more work must be done of all (except merely descriptive) kinds, before the science can be put on a satisfactory footing.

Even under the present adverse circumstances, a creditable amount of good work has been done in several directions, and we may reasonably expect that succeeding years will be hardly less fruitful. The harvest truly is plenteous but the laborers are few.

General Works on Mollusca.—But one publication which can claim to be of this nature has appeared in America in 1879. This is a "Manual of Conchology, structural and systematic, with illustrations of the species," by Geo. W. Tryon, Jr.; 8vo, Philadelphia, the author, 1879, *et seq.* Of this, three parts of Vol. I, *Cephalopoda*, have come to hand, and include 192 pages of text and seventy plates. The scope of the work is thus stated by the author: It is to be a "Conchological manual, which, while more comprehensive than any similar work hitherto published, shall be so condensed in text and illustration, that it may be issued at a much more moderate price. It will include, in systematic

order, the diagnoses of all the genera and higher divisions of the Mollusca, both recent and fossil, and the descriptions and figures of all the recent species; together with the main features of their anatomy and physiology, their embryology and development, their relation to man and other animals, and their geological and geographical distribution." "Each part will be complete in itself, Part 1 will contain the Cephalopoda; the Muricidæ will follow." "Only 250 copies will be published." It is but fair to say that the parts of this gigantic undertaking, which have so far appeared, comprise the results of a surprising amount of industry.

Anatomy and Development.—Perhaps the most important papers which have appeared in this department during the year, are those of Prof. W. K. Brooks in the "Scientific Results of the Session of 1878, Chesapeake Zoölogical Laboratory;" 8vo, 170 pages, 13 plates, Baltimore, Johns Hopkins University, 1879.

Of the two papers referred to, the first on "The Development of *Lingula* and the systematic position of the Brachiopoda," is the most extended (35–112 pp., 6 pl.) and important. The first portion is devoted to a description of the features of the embryos of *Lingula* (*Glottidia*) *pyramidata* Stm., with a review of previous investigations on the same subject. The second part reviews the "Bearing of the development of *Lingula* upon the systematic position of the Brachiopoda." The several very diverse views of different authors are discussed in the light of the new facts previously set forth, and especially that theory held and expounded with so much energy and wit by Prof. E. S. Morse, that the Brachiopods were (1) Annelids or (2) "Vermes."

The important contributions to our knowledge of the early stages of Brachiopods, made by Prof. Morse in the past, entitle any views of his to respectful consideration, such as is here accorded to them, but with the result of dismissing the first (which indeed had never been accepted in literal fashion by any naturalist of standing except Prof. Morse) very briefly, and for the second, concluding that "the Brachiopods then are 'Vermes' in the same sense that the Echinoderms, Mollusca, Tunicates and Vertebrates are" (l. c. p. 102), and reiterating views expressed in 1876, to the effect that, "as soon as we recognize that the Lamellibranchs are not to be regarded as typical Mollusca, and that all of the latter are to be traced back to a 'Veliger,' all difficulty seems to disappear, and it becomes plain, not only that Mollusca and Mol-

luscoida are related, but that they are connected so closely that the advisability of such a division is very doubtful."

Ten years ago many crudities, due to the defective state of our knowledge of the development of the Invertebrata, obscured the relations of many forms now more or less thoroughly understood. At that time the present writer took strong ground in favor of a position essentially similar to that which more lately has received the support of Prof. Huxley, and which the labors of Brooks have more thoroughly elucidated and now placed on a firm basis. As this position was vehemently contested at that time by Prof. Morse, and was considered by other good naturalists as somewhat unsafe, it is with more than ordinary pleasure that the writer now records the latest step of progress which, while it has corrected many of his own misconceptions, has resulted in proving the essential correctness of the main features of his hypothesis of that earlier time.

It is hardly necessary to add that the Tunicata, then left by both Morse and himself, as well as the great body of naturalists, in the company of the Molluscoida, have since been effectually divorced from them, and may be said to have hardly found even yet, with relation to other invertebrates, a definite location.

The second paper of Prof. Brooks on "Preliminary observations upon the development of the marine prosobranchiate Gasteropods," concerns the early stages of *Astyris* and *Urosalpinx*, and comprises an abstract of observations, with one plate.

Still another report on important biological work in this department, is Prof. Brook's "Abstract of observations upon the artificial fertilization of oyster eggs and on the embryology of the American oyster." *Am. Journ. Sci.*, XVIII, No. 108, December, 1879, pp. 425–427.

Important differences of breeding habits are pointed out between the *O. virginica* of America and the *O. edulis* of Europe. The eggs of the American oyster are fertilized outside the body of the parent, and the young swim at large during the period in which the fry of the European species are sheltered in the mantle cavity of the parent. At the breeding season each individual adult contains only eggs or spermatozoa. Segmentation is completed in about two hours, and follows substantially the course described for other Lamellibranchs by Lovén and Fleming.

The oldest ones which could be raised were almost exactly

like the embryos of *Cardium* as figured by Lovén. The oysters seemed fertile at hardly more than one year of age, and from ripe individuals millions of ova were artificially successfully fertilized.

A short paper on the anterior pair of muscles of the oyster, usually overlooked in descriptions of the genus, was presented to the Philosophical Society of Washington, by W. H. Dall, and their probable homology with the pedal muscles of Dimyarians suggested.

In the Journal of the Cincinnati Society of Natural History, July, 1879, Prof. A. G. Wetherby gives some notes in regard to the anatomy of *Bulimnæa megasoma* Hald., especially in regard to the form and appearance of the soft parts, the digestive tract and the reproductive organs, which latter are illustrated by cuts.

In a paper read at a late meeting of the Boston Society of Natural History, by Prof. R. P. Whitfield, some singular changes in the soft parts of the above-mentioned species are described as produced during confinement in an aquarium of successive generations, the progeny of a single individual. An abstract of this paper has appeared in the NATURALIST (Vol. XIV, No. 1, p. 5–12). The individuals of successive generations diminished in size and the male organs disappeared. This, which has been ascribed by Hyatt to a change in temperature (l. c. p. 52), is perhaps more probably due to a deficient food-supply (this species, according to Wetherby, is partially carnivorous) and the action of the physiological law to which Meehan has frequently called attention, of the greater persistence in cases of pauperization, of female or mother-functions and members.

"On the jaw and lingual dentition of certain terrestrial Mollusks, by W. S. Binney, Bull. Mus. Comp. Zoöl., v, No. 16. 8vo, pp. 332, 2 pl. Cambridge University press, Dec., 1879.

This important though brief paper comprises anatomical notes, chiefly in regard to the radula, of *Onchidella* (*Onchidium*?) *carpenteri* Binney; *Zonites whitneyi* Newc.; *Z. subplanus* Binn.; *Janulus stephanophora* Desh.; *J. bifrons* Lowe; *Urocyclus kirkii* Gray (?); *Cionella gloynei* Gibbons; *Hemitrochus milleri* Pfr.; *Plagioptycha duclosiana* Fér.; *Microphysa stearnsii* Bl.; *Triodopsis vultuosa* Gld.; *Mesodon sayii* Binn. var. *Chilhoweensis*; *M. devia* Gld.; *Pomatia humboldtiana* Val.; *Ochthephila tiarella* W. and B.; *O. abjecta* Lowe; *Plebecula lurida* Lowe; *Leptaxis undata* Lowe; *Veronicella* (sp. indet.) and *V. olivacea* Stearn andu-

losa Binn. and Bl.; *Simpulopsis corrugatus* Guppy; *Bulimulus schiedeanus* Pfr.; *B. immaculatus* Ad.; *Macroceramus inermis* Gundl.; *Cylindrella Chemnitziana* Fér.; *Omalonyx felina* Guppy (united by Binney and Bland to *O. unguis*); *Arionta intercisa* Binn.; and *Vitrina latissima* Lewis, which is erected into a new genus (p. 333) under the name of *Vitrinizonites*. It is related to *Vitrina* and *Zonites*, but differs by satisfactory characters. For a new species of slug from Natal, Africa, the (preoccupied) name of *Chlamydephorus* (rightly *Chlamydophorus*) is proposed, the species taking the name of *Gibbonsii* after its discover. *Pupa cincinnatiensis* Judge, is said to be a synonym of *P. contracta* Say, and *Tectula lincta* Lowe, from Madeira, is said to be viviparous.

These notes are followed by systematic references to the notes on various species of Mollusks in regard to which Mr. Binney has published anatomical observations or figures; by a complete bibliographical list of Mr. Binney's numerous contributions to science; and by a useful list of the known genera of slugs with their generic characters as far as they could be ascertained.

Mr. Binney has also contributed to the Annals of the New York Academy of Sciences, I, No. 9, pp. 257–262, with Pl. XI (May 9, 1879), a paper on the jaw and lingual dentition of certain Costa Rican land shells collected by the late Dr. Wm. M. Gabb. He describes anatomical features of *Limax semitectus?* Mœrch, *Bulimulus irazuensis* Angas, and of undetermined species of *Glandina*, *Helix* and *Tebennophorus*, together with two new genera and species, *Velifera gabbi* (allied to *Helicarion*) and *Crypto strakon* (mel. *Cryptostracum*) *gabbi*, a curious slug with a concealed rudimentary shell and teeth resembling those of *Polygyra*, etc.

The first essay toward a really scientific study of our American Nudibranchiata, is contained in a paper contributed by Dr. R. Bergh, of Copenhagen, to the Proceeedings of the Philadelphia Academy of Natural Sciences for 1879, pp. 71–132, "On the nudibranchiate gasteropod Mollusca of the North Pacific ocean, with special reference to those of Alaska," Part I, pl. I–VIII. This paper is almost wholly anatomical, and by the acknowledged highest living authority on the subject. Twenty-seven species are considered, of which two-thirds are new and most of the others are for the first time adequately characterized. The distribution of the North Pacific species is discussed, and the genera

subjected to analysis, while their exotic species are usually enumerated. Most of the forms are from Alaska, but several of the more elegant species are Californian, while a special interest attaches to the rediscovery at Unalashka, and identification by Dr. Bergh, of the singular and anciently described *Tritonia tetraquetra* of Pallas. A number of Cooper's ill-defined Californian species are now placed on a solid basis, and several new generic forms are characterized. The paper does not admit of a proper representation by an abstract, and the reader is referred for further information to the original. It will be followed by a second part containing eight additional plates, and is based, for the most part, on the collections of Mr. W. H. Dall in Alaska and California from 1865 to 1874.

Another paper, in part anatomical, based on the same collections, is that of Mr. W. H. Dall in the Proceedings of the U. S. National Museum, a "Report on the Limpets and Chitons of the Alaskan and Arctic regions, with descriptions of genera and species believed to be new" (l. c. pp. 281–344, Pl. I–V, Feb. 13, 1879). This paper contains a summary intended to exhibit all that is known in regard to the anatomy and development of the *Chitonidæ*, including the results of the author's investigations and a synopsis (with some additions and rectifications) of Carpenter's classification of the group, in which a large number of genera are for the first time characterized; and others, defined by Dr. Carpenter (in his table of the regular Chitons, 1873), are more fully alluded to. The plates represent dissections of the radula of forty-five species belonging to thirty-three genera, whereas not more than a dozen species had previously been figured, and of these only a few (by Sars and Lovén) in an intelligible manner. The author's observations so far as they extend agree in the main with those of Von Ihering, which were made about the same time at Trieste. The renal pore described by Ihering, but not found by Dall, appears from information received from the former, to have been due to a misconception. As the limpets had been already treated rather fully by the author, the list here given is merely a synopsis, with additions and corrections, of his previous work. The work so far as the region it covers has a somewhat monographic character, and it is hoped will serve as a preliminary to the elaborate monograph of Dr. Carpenter, which is in process of preparation under the direction of the Smithsonian Institution.

As a whole, the paper is too extended to admit of a thorough abstract. A few new Alaskan species are described in it.

In the Transaction of the Connecticut Academy, v., p. 177 *et seq.*, Prof. Verrill begins an exhaustive paper, largely anatomical, on the Cephalopods of the North-eastern coast of North America; Part I.—The gigantic squids (*Architeuthis*) and their allies, etc. The first two signatures of this paper bear date of December, 1879, and it is proper to call attention to it, though as a whole the paper will not make its appearance until some time in the present year, and therefore will more appropriately be discussed in a review of publications of 1880.

Descriptive, taxonomic and faunal papers.—While most of the papers enumerated under the preceding head, would, in part, be appropriately cited here, those about to be mentioned are such as could not properly be classed under the former caption.

Prominent among descriptive papers of each year for a long time, have been those of Verrill, based for the most part on material gathered by the U. S. Fish Commission and its collaborators. During 1879, however, the mollusca have been fewer than usual, and it begins to seem as if the molluscan fauna of the North-eastern American coast were pretty thoroughly described and enumerated so far as determination of the species is concerned. Still occasional novelties turn up, mostly deep-water or northern forms, and from time to time others may be expected. This year the American Journal of Science contains three papers by Prof. Verrill in which mollusca are described or enumerated.

In "Notice of recent additions to the Marine fauna of the eastern coast of North America, No. 3." l. c. XVII, March, 1879, p. 241–3, *Histioteuthis collinsii* Verrill is described and another cephalopod identified doubtfully as *Taonius hyperboreus* Stp. In the same, No. 4, April, 1879, pp. 311–15, *Acanthodoris ornata* and *citrina*, *Coryphella rutila* and *Cuthona stimpsoni* are described as new, while a number of notes are given relating to previously described species of gasteropods. In the same, No. 7, December, 1879, pp. 468–70, two new species and one new genus of cephalopods are described, namely, *Stauroteuthis syrtensis* Verrill, n. g. et sp. and *Octopus piscatorum* Verrill, sp. n. The former is stated to be somewhat distantly allied to *Cirroteuthis*.

Prof. Verrill also contributes a paper to the Proc. U. S. National Museum for November, 1879, pp. 165–205, under the title of

"Notice of recent additions to the marine invertebrata of the North-eastern coast of America," etc. Besides descriptions of many Polyzoa and a new Ascidian the author notes as new to the eastern coast, *Xylophaga dorsalis* Turton, *Lunatia nana* Möller (also found by Möller in Greenland, and by Dall in Alaska) and *Idalia pulchella* Alder and Hancock. *Dendronotus robustus* Verrill, is stated to be identical with and prior to *D. velifer* Sars, from Norway.

In the Proceedings of the Academy of Natural Sciences of Philadelphia for 1879, p. 16, Mr. W. G. Binney mentions *Arionta rowellii* and *A. facta* Newc., with *Binneya notabilis* Cp., as found on the Mexican island of Guadalupe off the coast of Lower California. He suggests that the Mexican genus *Xanthonyx* is probably synonymous with *Binneya*. In the same periodical Mr. Andrew Garrett gives a list of land shells inhabiting Rurutu, one of the Austral (Pacific) Islands with remarks on their synonymy, geographical range and descriptions of new species; l. c. pp. 17–30. It contains twenty-three species, of which eight are new. On page 31 of the Proceedings Mr. Garrett describes *Goniobranchus albopunctatus*, sp. n., from Huahine, Society islands.

In the *Canadian Naturalist*, VIII, n. s. No. 8, Mr. J. F. Whiteaves publishes a short paper of nine pages, "On some marine invertebrata from the west coast of North America," which contains among other things a very interesting list of mollusks from the coast of British Columbia, one of which, *Cardium richardsonii* is described as new. This paper (though stated to be published Dec. 20, 1878), is of such interest to the students of geographical distribution that I include a notice of it here. It partially fills a gap which has long existed in our knowledge of the invertebrata of the fauna existing between Puget sound and Alaska. This fauna for the most part is Oregonian in character and contains few locally characteristic mollusks.

In the report of the Chesapeake Zoölogical Laboratory (Johns Hopkins University), which contains the papers of Prof. W. K. Brooks, before mentioned, is a list by Mr. P. R. Uhler, of animals found at Fort Wool, in the Lower Chesapeake. This contains thirty-one species of mollusks, all of which had been previously known, though several were new to the region. It must be stated that the identification of one of these, as *Chiton cinereus* Lin., is doubtless an oversight; as that is a northern species, Arctic and

European in its distribution, and not known from any part of America.

In Prof. Wetherby's Notes on Limnæidæ, previously mentioned, he claims to have for the first time correctly identified *Planorbis glabratus* Say, since it was originally described, and characterizes as new *P.* (*Helisoma*) *duryi*, both coming from Florida.

In *Science News* for April 15, 1879, Mr. Arthur F. Gray notes the comparatively recent spread of *Litorina litorea* L., which, first described as American from Nova Scotia specimens, doubtless was brought over on ballast, and has reached as far south as Stonington, Connecticut. The writer can positively state that twenty years ago it was not found on the shores from Beverly to Boston, though now rather common there, and such records of its migration as the above are interesting and valuable.

In the Proceedings of the American Philosophical Society (Sept. 1879) pp. 282–288, Dr. J. G. Cooper publishes "Notes on some land-shells of the Pacific slope." This is chiefly a criticism of some of Mr. Binney's work. Dr. Cooper thinks that the little Alaskan *Patula* is not *pauper* of Gould, but a comparison with Gould's types would have led him rather to sustain the identification of Binney and Bland, as the specimens are precisely similar and from a similar faunal region.

The shells of the Colorado desert are the subject of an article by R. E. C. Stearns in the March number of the AMERICAN NATURALIST. Although fossilized shells, the paper has a right to mention here, from the fact that it is a matter of doubt whether all these species are fully extinct even in America, while Dybowski has described large numbers of *Tryoniæ* (under other names) from Lake Baikal, one species of which is hardly distinguishable from *T. clathrata* Stm., figured by Stearns.

Mr. W. W. Calkins, who has repeatedly visited Florida on scientific tours, published a paper on the "Marine Shells of Florida," in the Proceedings of the Davenport Academy of Sciences in 1878, comprising a catalogue, descriptions of supposed new species and some remarks on the distribution of species included in his list.

This paper was noticed in *Science News* of February 15, 1879, and in the number for April 15th, Mr. R. E. C. Stearns points out some errors of identification which occur in Mr. Calkins' paper, whereby West American and Floridian species were included under one name.

In Bulletin No. 14 of the U. S. National Museum, we have a "Catalogue of the Collection illustrating the animal resources and the fisheries of the United States," prepared under the direction of Mr. G. Brown Goode, and referring to the collection exhibited by the National Museum and the Smithsonian Institution at Philadelphia in 1876.

Part II, of this Bulletin (pp. 249–271) comprises the "Catalogue of illustrations of the Economical Invertebrates of the American coasts, by W. H. Dall." Nine pages (251-259) of this relates to Mollusks, in which, of course, the pearl shells and oysters occupy the larger part. Had the uses of exotic Mollusks also been considered, the list might have been considerably augmented; the number of species given among the Gasteropods and Lamellibranchs includes few except those actually used for food or bait. A very much larger number might have been enumerated as possibly available, but this was not thought desirable.

A very useful aid to all students of the fauna of the North-east American coast, is the "Preliminary Check-list of the marine Invertebrata of the Atlantic coast from Cape Cod to the Gulf of St. Lawrence, by A. E. Verrill," prepared for the U. S. Fish Commission, of which the author's edition was printed at New Haven in June, 1879. Four hundred and seventy-four species and varieties of Mollusks and Molluscoids are enumerated, and forty-three Tunicates, distributed as follows: Cephalopods, 12 sp.; Gasteropods (including 44 sp. Nudibranchiates), 187 sp.; Pteropods, 4 sp.; Solenoconchs, 3 sp.; Lamellibranchs, 122 sp.; Brachiopods, 3 sp. (and two doubtful ones); Polyzoa, 141 sp.; and Tunicates, 43 sp. and varieties. A comparison of these numbers with those of Stimpson's Smithsonian Check-list of 1860, "Arctic seas to Georgia," including practically all that was then known of the Atlantic coast, shows the vast progress that has been made. Stimpson's numbers are as follows: Cephalopods, 16 sp; Gasteropods (including 22 Nudibranchs), 240 sp.; Pteropods, 6 sp.; Solenoconchs, 2 sp.; Lamellibranchs, 189 sp.; Brachiopods 3 sp. (2 doubtful); Polyzoa, 27 sp.; and Tunicates 29 sp.; total for the whole Atlantic coast, 514 species and varieties, against 517 now catalogued for the small portion between the Gulf of St. Lawrence and Cape Cod alone.

This great advance may be almost wholly attributed to the researches of the officers of the U. S. Fish Commis-

associated with them, and especially to the untiring activity of the author of this check-list.

In his "Zoölogy for Students and general Readers," by A. S. Packard, Jr., the nervous system and pedal ganglia and otocysts of *Mya arenaria* are figured from drawings prepared by Dr. W. K. Brooks. Prof. Packard also gives a general account of the anatomy of *Lunatia heros*, and of *Loligo pealii.*

A new form of *Helix* from California, apparently related to *H. mormonum*, is described by Mr. R. E. C. Stearns in the Annals of the New York Academy of Sciences, I, No. 10, Nov., 1879, article XXVI, with a figure, under the name of *H.* var. *circumcarinata* Stearns.

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RECENT LITERATURE.

SMITH'S BRAZIL; THE AMAZONS AND THE COAST.[1]—Of the many delightful books which have been written on Brazil, this is, to our taste, the most interesting. Its author was, for a time, a member of the Geological Survey of Brazil under Prof. Hartt, and brings to the task of writing a popular book, many qualifications. His work displays scientific knowledge, acute powers of observation, an insight into the social and business interests of the inhabitants, and an enthusiastic love of nature. His style is vivacious, and we are carried with ready facility from forests to fevers, from plains to insects, from politics to navigation, while a narrative of travel appears here and there as we pass from one scene to another. The variety of subjects treated will interest a large circle of readers. As Mr. Smith is an accomplished entomologist, his contributions to this department have an especial value. The statements of the results of a day's collecting of beetles are remarkable. On December 17th he took 394 specimens of 275 species in about eight hours. On January 29th, 471 specimens of 268 species. The famine of Ceara, 1877–78, of which Mr. Smith was an eye-witness, is graphically described. The industrial statistics will interest American merchant especially. The execution of the work, including the numerous wood engravings, is admirable.

NATURAL SCIENCE AND RELIGION.[2]—In these lectures Dr. Gray furnishes the theological students of Yale with his reasons for maintaining a belief in the evolution of animal and vegetable spe-

[1] *Brazil; The Amazons and the Coast.* By Herbert H. Smith. Illustrated by sketches by Champney, etc. New York, Chas. Scribner's Sons, 1879. 8vo, pp. 644.

[2] Two lectures delivered to the Theological School of Yale College. Chas. Scribner's Sons. 8vo, 1880.

cies. Though these are familiar to most of our readers, they are not so to the average theological student; so that our thanks are due to Dr. Gray for his clear and simple statement of them. He lays a good foundation for the further discussion of questions which more immediately interest theologians, viz: the evolution of mind and character. Into this field Dr. Gray does not enter, but confines himself to a pretty thorough exposition of common sense views of creation, such as would be naturally entertained by every healthy mind were it not for the difficulties raised by too comprehensive theologies.

MOSELEY'S NATURALIST ON THE CHALLENGER.[1]—In this record, by one of the naturalists of the scientific staff of the *Challenger*, we have probably the cream of the more important discoveries made by this famous expedition. The story is not told in an elaborate way, but rather as noted down originally in the author's note book and letters home. While immense collections have been made by this expedition to be elaborated by specialists in the volumes of the Admiralty reports, it is not improbable that the results already published by Mr. Moseley are quite as important as those yet to be worked out. We refer to his elaborate discussions on the development and anatomy of Peripatus, by which this singular form has been taken from among or near the worms and placed with the Tracheata; also to his papers on the Hydroid corals, Millepora, the Stylasteridæ and Heliopora. The results of these investigations were of the highest value to biological science. These, however, were not deep sea forms; of these the most important and aberrant was a deep sea ascidian (*Octacnemus bythius* Moseley). Mr. Moseley states that indeed the deep sea animals are mostly closely allied to shallow water forms. "They appear also to live associated together in closely the same manner as their shallow water representatives." Moseley says nothing as to the fact that these deep sea forms are a survival of the Cretaceous fauna, as they probably are — but the general results of the *Challenger* are but an extension of what had been brought out by the Scandinavian, American and British deep sea researches which had established the fact that there was a deep sea or abyssal fauna; the researches of Pourtales and Agassiz in the Floridan channel showing that this fauna, with its arctic waters, underlay, at depths below 500 fathoms, the tropical life and waters.

Agassiz's idea, however, Moseley says, that many important fossil forms might exist at great depths was also dispelled. This idea was, however, based on a misconception. The most generalized forms, those most likely to survive great vicissitudes and changes

[1] *Notes by a Naturalist on the "Challenger;"* being an account of various observations made during the voyage of H. M. S. *Challenger* round the world in the year 1872–1876. By H. N. Moseley, F.R.S., with a map, two colored plates and numerous wood-cuts. London, Macmillan & Co., 1879. 8vo, pp. 606.

of level and temperature, are forms like Lingula, Limulus and Amphioxus, which live in shoal water and evince the wonderful vitality which is the assurance of their high antiquity. It was, moreover, useless to look for allies of the trilobites in the abysses of the sea, when it was already known that in Limulus we had a form as closely allied to the trilobites as one order of insects are to another.

Mr. Moseley's book is unpretentious, thoroughly interesting from the large number of novel views and facts, and will remain the best popular record of the voyage of the *Challenger*.

CLARKE'S DEVELOPMENT OF THE SALAMANDER.[1]—The external changes undergone by one of our common salamanders are described and figured by Dr. Clarke in this interesting paper, which for the first time gives a connected account of the development of an American amphibian. The eggs of this common salamander are attached in bunches of from three or four to two hundred in a gelatinous mass to the stem of some aquatic plant or submerged leaves. After segmentation and the appearance of the medullary folds, with the groove between them, the folds close in, forming the neural tube. The body elongates, becomes ciliated and rotates horizontally upon its axis. The head is next marked off and the optic vesicles, branchial lobes and head-balancers appear; then the fore limbs begin to bud out, the heart soon pulsates, and then the nasal pits and mouth are indicated; the tail and dorsal fin grow rapidly and the branchial lobes are divided into three pairs of gills. The head, mouth and gills are elaborated, the digits on both pair of limbs appear, and by the hundredth day after segmentation begins, the gills are resorbed and the animal assumes the adult state.

PENNING'S TEXT BOOK OF FIELD GEOLOGY.[2]—The first edition of this valuable book appeared about a year ago and attracted considerable attention. The first edition contained 227 pages, while to this last edition about one hundred pages of new matter are added. The growing popularity of geological field excursions among the students of our higher schools and colleges, renders such hand books indispensable. The chapters on geological surveying, sections, lithology, &c., are handled in a practical manner, and are simple, clear and intelligible. The illustrations are also well chosen. Not the least important portion of this book is the section on palæontology, by Mr. Jukes Browne. In it he shows very clearly the valuable aid of fossils in determining

[1] *The Development of Amblystoma punctatum Baird.* Part I. External. Extracted from Studies from the Biological Laboratory of the Johns Hopkins University, No. 1, 1879.

[2] *A Text-book of Field Geology.* By W. HENRY PENNING, F.G.S. With a section on Palæontology. By A. J. JUKES BROWNE, B.A., F.G.S. Second edition, 8vo, pp. 319. Geological map and twenty-nine wood cuts. (London, Baillière, Tindall & Cox, 1879.

strata in the field, a subject which at the present day some otherwise excellent scientific men are attempting to depreciate.

A second work by the same authors on engineering geology will soon be published. It purports to be a practical guide in the interpretation of those geological phenomena by which engineering works, building materials and water supply are effected, and in the methods of surveying, by which such geological conditions are determined.

SKETCHES OF THE PHYSICAL GEOGRAPHY AND GEOLOGY OF NEBRASKA.[1]—This is one of the most interesting and valuable books yet published on the scientific and practical resources of the State of Nebraska. Prof. Aughey has been for many years a most enthusiastic student of its geography and geology, until he has become the reliable authority all over the country. His paper on the Loess published in the Annual Report of the Geological Survey of the Territories for 1874, called out a very complimentary letter from Mr. James Geikie, of Scotland. In this book he has elaborated his former sketches on various subjects connected with the State, and presented them in a clear and graphic manner, which cannot but render them very attractive to the general reader. Although the first edition has been issued but a few months, already a second edition is called for. We congratulate Prof. Aughey on his well-deserved success.

ARCHIVES OF COMPARATIVE MEDICINE AND SURGERY.[2]—We note with interest the appearance of this new periodical. Its objects are divided between economic and pure science, so as to appeal to a larger constituency than if its scope were confined to either alone. We note various interesting statements of observations on the pathology and anatomy of the lower animals, especially of the Vertebrata. One of these, on the Island of Reil, we transfer to our notes. The *Archives* has a wide field, and, under its present able editor, we hope for its success.

TRAQUAIR ON PLATYSOMIDÆ.[3]—This memoir fills a hiatus in our knowledge of palæozoic fishes, in a very satisfactory manner. As defined by Dr. Traquair, the family *Platysomidæ* includes the genera *Eurynotus* Ag., *Benedenius* Traqu., *Mesolepis* Young, *Eurysomus* Young, *Wardichthys* Traqu., *Chirodus* McCoy, and *Platysomus* Agass. These genera are fully defined from internal and external characters, and are illustrated by good plates, which include several restorations. Dr. Traquair has been very successful in working out the osteology of these forms, and in discovering

[1] *Sketches of the Physical Geography and Geology of Nebraska.* By SAMUEL AUGHEY, Ph.D., LL.D.

[2] *Archives of Comparative Medicine and Surgery;* a Quarterly Journal of the Anatomy, Pathology and Therapeutics of the Lower Animals. Edited by EDWARD SPITZKA, M.D. New York, W. L. Hyde & Co., Printers.

[3] On the Structure and Affinities of the *Platysomidæ*. By RAMSEY H. TRAQUAIR, M. D. From the Transactions of the Royal Society of Edinburgh, Vol. XXIX, 1879.

new characters. He throws much light on their systematic position, especially in demonstrating the differences which distinguish them from the *Dapediidæ*, and their near affinity to *Palæoniscidæ*. Indeed the author scarcely adduces sufficient ground for their separation as a family from the latter.

Two of the important characters on which he lays most stress, viz., the non-coincidence of the median fin-rays with their interneural and interhæmal bones, and the absence of suboperculum, undoubtedly remove the fishes which possess them, from the order *Isospondyli*, where the present writer formerly placed them. The degree of ossification of the cranial and vertebral bones, is of less importance. Dr. Traquair places this family and its allies in the *Chondrostei* (which he calls *Accipenseridi*) with *Accipenseridæ*, etc. But he does inform us as to the structure of the articulations of the pectoral and ventral fins; perhaps his material does not permit it. A comprehension of this part of the skeleton, is, in the present writer's estimation, necessary to the determination of the position of any fish in the system. The *Chondrostei* form a group, intermediate between the *Crossopterygia* and other fishes (or *Actinopteri*)[1] having the ventral fin of the former, and the pectoral of the latter. From all the evidence yet advanced, the ventral fins of this group appear to be those of the tribe *Actinopteri*, with which they should probably be associated. In this group they will occupy the lowest position, below the *Ginglymodi* (*Lepidosteidæ*, etc.), differing from all the fishes which compose the former, in the primitive character of the fin-rays already mentioned. They will form a distinct group of the same rank as those I have called orders, to which the name of *Lysopteri* may be given. The definition will be, *actinopterous fishes with the median fin-rays not joined to the interhæmal and interneural bones, and not coinciding with them in number; and without suboperculum.*

Dr. Traquair shows the entire insufficiency of Prof. Young's system of palæozic fishes, but seems not to be sure but that *Lepidosteus* has some relatives from below the upper cretaceous formations. He writes ganoids, with a capital G, as though it were a natural group. Certainly the arguments adduced by the supporters of this division (*e. g.* Dr. Lütken), as well as by its opponents, show that it does not conform to Dr. Traquair's definition of a true division (p. 386); "What we require is that the assemblage of characters shall be exclusive."

The characters adduced by Dr. Traquair, appear to confirm the writer's reference of the *Dapediidæ* to the *Isospondyli*.—*E. D. C.*

We have seldom met with a case of more unblushing piracy than lies before us in "Rand, McNally & Co.'s Geological and Mineralogical Map of Colorado, copyright secured 1879."

[1] Proceed. Amer. Ass. Adv. Sci. 1878. 293.

Although this is simply a copy of Dr. Hayden's U. S. Geological Survey Map, no recognition of the fact appears on the publication in question. The officers of United States Surveys are very liberal with their publications, and will furnish every facility to publishers and editors, expecting only the easily given return of credit. This every compiler is bound to give, by all sentiments of both honor and patriotism.

RECENT BOOKS AND PAMPHLETS.—De i de brasilianske Knoglehuler fundue Navlesvin-Arter. Af. J. Reinhardt. (Repr. from Vidensk. Meddel. fra den naturh. Foren. i Kjöbenhavn.) 8vo, pp. 33, 1880. From the author.

Reports on the results of dredging under the supervision of Alexander Agassiz, in the Caribbean sea, 1878–79, by the United States coast survey steamer *Blake*, Commander J. R. Bartlett, U.S.N., commanding. VI. Report on the Corals and Antipatharia. By L. F. Pourtales. (In Bull. Mus. Comp. Zoöl., Vol. VI, Feb., 1880.) From the museum.

Some thoughts on the glycogenic function of the Liver. II. Disposal of Waste. By Joseph LeConte. (Ext. from Am. Jour. Sci., Vol. XIX, Jan., 1880.) 8vo, pp. 25–29. From the author.

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Supplementary note on the Vertebræ of Ornithopsis Seeley, Eucamerotus Hulke. By J. W. Hulke, Esq., F.R.S., F.G.S. (Ext. Quar. Journ. Geolog. Soc., Feb. 1880.) 8vo, pp. 31–35, pls. 2. From the author.

Vectisaurus valdensis, a new Wealden Dinosaur. By J. W. Hulke, Esq., F.R.S.,

F.G.S. (Extr. Quar. Jour. Geol. Soc., Aug., 1879.) 8vo, pp. 421–424. From the author.

Report on the Mammals and Birds of the general region of the Big Horn river and mountains of Montana Territory. By Chas. E. McChesney, A. A. Surgeon U.S.A. (Ext. from Appendix SS [Report of Lieut. Maguire, Corps of Engineers] of the Annual Report of the Chief of Engineers, 1879.) 8vo, pp. 2371–2395. From the author.

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The Archives of Comparative Medicine and Surgery. A Quarterly Journal of the Anatomy, Pathology and Therapeutics of the Lower Animals. Edited by Edward C. Spitzka, M.D. Vol. 1, No. 1, pp. 56, New York, Jan., 1880. From the editor.

Sea Air and Sea Bathing. By John H. Packard, M.D. 12mo, pp. 120. Philadelphia, Presley Blackiston, 1880. From the publishers.

Notes on the Bartram Oak, Quercus heterophylla Michx. By Isaac C. Martindale. 8vo, pp. 24. Camden, 1880. From the author.

Studies from the Biological Laboratory of Johns Hopkins University, Baltimore. No. IV. The development of the Oyster. By W. K. Brooks. 8vo, pp. 81, pls. 10. Acquisition and loss of a food-yolk in Molluscan eggs. By W. K. Brooks. 8vo, pp. 107–116, pl. 1. Baltimore, 1880. From the University.

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GENERAL NOTES.

BOTANY.

TRANSFORMATION OF ANTHERS INTO OVARIES.—In Gray's Manual, under *Salix livida*, we read, "A transformation of the *anthers into imperfect ovaries* is frequently observable in this species," and in the second edition, was added, "and occasionally in some others." Lately I found a *Salix discolor*, which no doubt is a female, and has on many branches monœcious catkins, the *ovaries fully developed*, some with a few staminate flowers between the pistillate, others with only a few pistillate flowers between many staminate ones, quite irregularly distributed, sometimes all the upper ones and a few in the middle and at the bare pistillate. This would agree (partly) with what Wichura said, in 1847, in a paper on the morphology of the pistil of Salix. He remarks: "The monstrous transformation of the *pistil into stamina* shows that the pistil consists of two laterally situated leaves. The style has two stigmata of which each splits mostly in two. The position of the stigmata is different, they correspond either with the middle line of the carpophyll, and thus are lateral, or correspond with the sutures as in Cruciferæ, and are posterior and anterior." It may be that the transformation takes place in both ways, but in the present case I am sure that the plant is originally pistillate.

With what Wichura said about the position of the stigmata, I cannot agree. First, the carpophylls are not lateral, but anterior and posterior, corresponding the one with the gland, the other with the scale; this I think is generally known, though I find it nowhere mentioned, and then I found in all our species the stigmata, corresponding with the carpophylls, and even in those European species (*S. caprea, aurita, cinerea, viminalis*), in which, according to Wichura, the stigmata correspond with the suture. The ovary of the Cruciferæ has a septum and the stigmata correspond with the placentæ, which run along the sutures. The ovary of Salix has no septum, the stigmata correspond with the placentæ, which are in the middle of the base of the carpophylls—*Fred. Brendel.*

ADDITIONS TO A HISTORICAL SKETCH OF BOTANY.—I send you some additional notes to my historical sketch, which appeared in the December and January numbers of the NATURALIST, with some corrections suggested by Dr. Engelmann. Dr. G. Engelmann, was born in February, 1809, and went to Missouri in 1832, residing in St. Louis since 1835. He knew Jos. Frank, in Heidelberg, 1827, where he was known under the nickname "plant hyena!" In 1835, Engelmann collected in Arkansas, and he thinks that Beyrich went there with Gen. Leavenworth. In Texas, Berlandier collected in the year 1834. Lindheimer came to West Texas in 1844. From Dr. Parry I learn that he published in Owen's Report, 1852, pages 606-622, a list of Iowa and Minnesota Plants collected in 1848.

Dr. Thos. Coulter's collections made in California in 1831–32, were published in the Journal of the Royal Geographical Society, Vol X. page 59: Notes on Upper California, communicated by Dr. Thomas Coulter, read March 9th, 1835, contains a map and itinerary. He met Douglas at Monterey, Nov., 1831, made a trip across the Colorado desert to the junction of the Gila and Colorado rivers, in spring of 1832. On his return to England, he was appointed Curator of the Herbarium, at Dublin, and died in 1840. This note I owe to Dr. Parry.—*Fred. Brendel.*

THE FLY-TRAP, ITS FIRST DISCOVERY.—The fly-trap (*Dionæa muscipula*) has lately been much spoken of; so it will be interesting to learn when this plant was first made known. John Ellis, (1711–1776), a London merchant, received in 1769, from Philadelphia, the plant and described it with drawings in "Directions for bringing over seeds and plants from the East Indies and other distant countries, in a state of vegetation, to which is added the figure and botanical description of *Dionæa muscipula*," London, 1770. The same gentleman published in 1771, "Copies of two letters to Dr. Linnæus and Mr. W. Aiton," containing descriptions and drawings of two other North American plants, *Illitium floridanum* and *Gordonia lasianthus.*—*F.*

ARENARIA GRŒNLANDICA NEAR MIDDLETOWN, CONN.—I would also report *Arenaria grœnlandica* Spring., as occurring in this vicinity. I have observed it in two places, both summits of rocks. It appears to grow in the very shallow bed of soil that collects on exposed rocky knobs, and is very abundant in these two narrow limits. The flowers are larger and the plants more luxuriant than in specimens from Greenland that I have seen, yet its identity is undoubted, and on the authority of Professors Gray and Eaton. The rocks on which it is found, occur on hills that rise two hundred feet or thereabouts, above the general level of the surrounding country.—*Henry L. Osborn, Wesleyan University.*

BOTANICAL NOTES.—In the *Botanical Gazette*, for April, Mr. I. C. Martindale discusses the germination and growth of the parasite, *Orabanche ramosa*, and M. E. Jones records his observations on remarkable forms of *Triticum repens*.——*Grevillea* for March notices New York fungi.——According to Prillieux, the roots of *Hartwegia ramosa* are negatively heliotropic, lengthening both by day and by night, due as he thinks, to the increased amount of growth on the illuminated sides. We also learn from the *Journal* of the Royal Microscopical Society for April, that a luminous fungus has been reported from the Andaman Islands; it is an agaric of small size, but exceeding in brilliancy anything which has hitherto been observed.——The influence of light on the movements of Desmids, has been investigated by E. Stahl, who finds that the cell of Closterium shows a tendency to place its longer axis in the direction of the rays of light, and that there is also a polarity between the two halves of the cell, in consequence of which, one is attracted towards, and the other driven away from the source of light. There is also a slow movement of the individual along the bottom in the direction of the source of light. When the light is very intense, the conditions are reversed, and the cell places itself with its longer axis at right-angles to the direction of the light. Observations by Gobel on Micrasterias and on the influence of light on the spores of low plants are noticed.——Ferdinand Lindheimer, the collector of "Plantæ Lindheimerianæ," lately died at New Braunfels, Mexico, aged about 78.——In a pamphlet printed at Camden, N. J., and entitled "Notes on the Bartram Oak, *Quercus heterophylla* Michx.," Mr. I. C. Martindale enters into an elaborate discussion of the reasons why the foregoing name given by Michaux should be maintained, and its rank as a good species established. The immediate occasion for the essay, was the discovery of some trees near Mount Holly.

ZOÖLOGY.[1]

THE ISLAND OF REIL.—Dr. Spitzka has advanced reasons for denying the current theory that the Island of Reil is the locality

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

of the function of speech. He find it to be very large in the hippopotamus, relatively three times as large as in the horse, while it is very much reduced in the seal. On the other hand, in the porpoise it is relatively larger and considerably more convoluted than in man. It differs from that of man in being highest behind and tapering forwards; in man it is higher in front and tapers backwards.

ON THE INTERNAL STRUCTURE OF THE BRAIN OF LIMULUS POLYPHEMUS.[1]—Several years ago I attempted to study the brain of the horse shoe crab (*Limulus polyphemus*), and had it sliced into a large number of sections. Owing to interruptions these sections, made from unstained alcoholic specimens, were not examined: during the past winter I have been able with the aid of Mr. N. N. Mason, of Providence, to take up the study afresh. Mr. Mason has kindly made sections, both transverse and horizontal, stained with osmic acid; also sections of the brain of the supra-œsophageal ganglion of the lobster, stained with picro-carmine, for comparison. The following results, then, are based on over two hundred sections of the supra-œsophageal ganglion of Limulus, but more especially on one brain, which was cut by Mr. Mason into fifty-six sections, from $\frac{1}{1000}$ to $\frac{1}{500}$ of an inch in thickness, and another cut into over forty. The examination of a few sections of the lobster's brain, enabled me to comprehend more readily the recent papers of Dietl, Newton and Krieger on the brain of the Decapodous Crustacea and of the insects, and thus give me a standard of comparison by which to study the topography and histology of the brain of Limulus.

General Anatomy of the Brain.—The singular relations of the central nervous system of the adult Limulus, have been fully described and beautifully illustrated by A. Milne Edwards, and Dr. Dohrn and myself have described its general anatomy in the larval stage. The central nervous system of Limulus consists of an œsophageal collar, mostly made up of six pairs of ganglia, from which nerves are distributed to the six pairs of foot-jaws (gnathopods), while the ring is closed or completed in front by the brain, or what corresponds to the supra-œsophageal ganglion of normal Crustacea and insects. In these Arthropoda, the brain is situated in the upper part of the head in a plane parallel to but quite removed from that of the rest of the ganglionic chain; in Limulus, however, the brain is situated directly in front of and on the same plane with the rest of the central nervous system. Milne Edwards states that the œsophageal ring, as well as the posterior part of the nervous system, is enveloped by an arterial coat; he also states that the brain and nerves are enveloped in a similar arterial coat, but this we have failed to find; the brain is protected by a thick membrane ("perineurium" of Krieger) formed of fibrous connective tissue, and the nerves are protected

[1]Read at the meeting of the National Academy of Sciences, held at Washington, April 21, 1880.

by a continuation of this membrane, as several longitudinal sections of these nerves have taught us. The brain in a Limulus ten inches long, exclusive of the caudal spine, is about five or six millimetres in diameter; it is flattened slightly above, and on the upper side has a shallow median furrow, indicating that it is a double ganglion. Three pairs of nerves and a median unpaired one (the ocellar), arise from the upper third of the anterior face of the brain. The two optic nerves are the largest ones, arising one on each side of the median furrow, so that the fifth to fifteenth sections made by the microtome, pass through them. Next below (from above downwards) is the origin of the ocellar nerve, which, as described by A. Milne Edwards, is single, arising from the median line; on each side and in nearly the same plane, arise two tegumental nerves, and directly below a second pair of larger nerves (fronto-inferior tegumental) descend vertically. No nerves arise from the lower half or two-thirds of the brain, which is smooth and rounded, with no median furrow underneath. It will thus be seen, that, as stated by A. Milne Edwards, there are no antennal nerves, such as exist as a rule in Arthropods except Arachnida. This we have proved in the same manner as Milne Edwards, by laying open the arterial coat or modified neurilemma, which reaches to the posterior end of the brain, and seeing that the fibres of the nerves sent to the first pair of legs originate quite independently of the brain itself.

Internal Structure and Histology of the Brain.—Transverse sections of the brain throw but little light on the topography, as the nerve fibres extend horizontally, the nerves being sent out horizontally and from the anterior end only of the brain; hence the examination of nearly two hundred sections threw little light on the topography, and considerable time was spent in a vain and baffling attempt at understanding the geography of this ganglion.

The study of two brains each sliced horizontally into about fifty sections, carefully mounted by Mr. Mason in consecutive order, finally enabled me to arrive at a tolerably complete idea of the relations of parts, so that I could mentally construct a model of the brain of Limulus, and compare it with the normal Arthropod brain.

The histological elements of the brain of Limulus are three in number. 1. Large ganglion cells, filled densely with granules and with a well-defined nucleus similarly filled and with a granular nucleolus. These cells may be crowded or loose, with the granules fewer in number, and with loose, thick cell-walls; they terminate in large fibres which sub-divide. 2. Similar cells, but smaller with less protoplasm, and like those in the lobster's brain. 3. Nerve fibres; these, like the large sized ganglion cells, from which they originate, are stained tawny yellowish-brown with osmic acid. These fibres are large, coarse, their granular contents very homogeneous, and they closely resemble the nerve fibres distributed to the compound and simple eyes. Certain fibres near the origin of the optic nerves, are distinctly nucleated

at intervals. 4. Rounded masses, consisting wholly of nuclei, enclosed in a network of fibres, which stain dark brown with osmic acid; these bodies form the larger part of the substance of the brain, while staining dark brown with osmic acid; in unstained alcoholic sections these masses are dark or grayish, the substance or fibres enclosing them, being whitish, by transmitted light. The brain is enveloped by a thick perineurium, formed of a fibrous tissue, and some (probably) elastic tissue, which occasionally penetrates into the brain-substance between the white rounded fungoid masses, forming the mesh-work surrounding them. The general topography of the brain of Limulus is on a simple plan compared with that of Decapodous Crustacea and insects. The brain is mostly composed of large irregular rounded masses or balls of nuclei, with a thick fungoid or ruffle-like periphery, formed by a layer of secondary smaller rounded granular masses. The center of the primary masses is stained paler brown by osmic acid. These masses are often seen in section, rounded, but more often are irregular, not closed spheroids; these fungoid or nucleogenous bodies extend through the brain like ruffles. The lower half or two-thirds of the entire brain is apparently filled with these nucleogenous bodies, as we may provisionally designate them. In the upper third of the brain, whence the nerves originate, the larger ganglionic cells and the nerve fibres appear, and preserve a definite topographical relation to the entire brain. The nucleogenous bodies are confined at the top to each side of the brain; the central and hinder regions are filled with the large ganglionic cells, mixed with numerous much smaller ones, and the mass of nerve fibres which spring from them, becomes larger from the upper third to the top of the brain where the optic fibres originate. Opposite the beginning of the optic nerves, these large nerve fibres are seen directed towards the origin of the nerves as if they were the roots, as they undoubtedly are. In the section passing through the ocellar nerve and the tegumentary nerves on each side, the fungoid masses are situated in the front of the brain; but they disappear from the front higher up at the origin of the optic nerves, and occupy a much more restricted area on the sides of the brain. Thus the tract of nerve fibres on either side of the brain is irregularly wedge-shaped, the apex situated near the centre of each hemisphere, and the base spreading out on the top, thus crowding to the outer walls the nucleogenous bodies.

It would thus appear as if the lower half of the brain were in an indifferent state,[1] and that the dynamic part were confined to the upper third, the region giving origin to the nerves of sensation.

[1] This area, made up of granules and nuclei, seems really to be connective tissue, and to represent the connective tissue in which the ganglia of the embryo of the young larva are embedded. There seems no reason why the brain should not be partly formed from connective tissue as much as the remaining ganglia, as we have seen them to be in different sections of different ganglia, all or nearly all except the supra-œsophageal one.

The asymmetry of the brain is remarkable; the large ganglionic cells are most abundant in the center behind the middle and from there to the posterior side of the brain; a median line is slightly indicated by the arrangement of the fungoid masses. The tract composed of large nerve fibres with scattered ganglionic cells on the left side is very much more extensive than on the right.

Comparison with the brain of other Arthropods.—So wholly unlike in its form, the want of antennal nerves, and internal structure, is the supra-œsophageal ganglion, or "brain," of Limulus to that of insects and the higher Crustacea, that it is very difficult to find any points of comparison.

Histologically, judging by my specimens of the brain of the lobster which are stained with carmine, the brain of Limulus agrees with that of other Arthropods in having similar large ganglion-cells; the smaller ganglion-cells, so abundant in the brains of insects and Crustacea, are wanting in Limulus. There are, in Limulus, no *ballen-substanz*-masses homologous with those of the other Arthropods nor any "mush-room" bodies.

Topographically the internal structure of the brain of Limulus is constructed on a wholly different type from that of any other Arthropodous type known, so much so that it seems useless to attempt to homologize the different regions in the two types of brain. The plan is simple in Limulus; much more complex in Arthropods, especially in the brain of the craw-fish, as worked out by Krieger, as in the Decapodous brain there arise two pairs of antennal nerves besides the optic pair, and in external form the two types of brain are entirely unlike. The symmetry of the brain of the crayfish, as of the lobster and insects, is marked throughout, each hemisphere exactly repeating in its internal topography, the structure of the opposite side; the symmetry of that of Limulus is obscure and imperfect.

THE FOOD OF BIRDS.—Under this title Prof. S. A. Forbes has published in the Transactions of the Illinois State Horticultural Society, a valuable report on the food of the thrushes. In Illinois there are estimated to be three birds to an acre during the six summer months. We make the following extracts: "It is my own opinion that at least two-thirds of the food of birds consists of insects, and that this insect food will average, at the lowest reasonable estimate, twenty insects or insects' eggs per day for each individual of these two-thirds, giving a total for the year, 7200 per acre, or 250,000,000,000 for the State—a number which, placed one to each square inch of surface, would cover an area of 40,000 acres.

"Careful estimates of the average number of insects per square yard in this State, give us at farthest 10,000 per acre for our whole area. On this basis, if the operations of the birds were to be suspended, the rate of increase of these insect hosts would be accelerated about seventy per cent., and their numbers, instead of

remaining year by year at the present average figure, would be increased over two-thirds each year. Any one familiar with geometrical ratios will understand the inevitable result. In the second year we should find these pests nearly three times as numerous as now, and with that astounding acceleration of increase characteristic of geometrical progression, they would multiply until in about twelve years we should have the entire State carpeted with insects, one to the square inch over our whole territory. I have so arranged this computation as to exclude the insoluble question of the relative value of birds and predaceous or parasitic insects, unless we suppose that birds eat an undue *proportion* of beneficial species.

"Take another view of this matter. According to the computation of Mr. Walsh, the average damage done by insects in Illinois amounts to twenty millions dollars a year. Large figures certainly; but when we find that this means only about fifty-six cents an acre, we begin to see their probability. Few intelligent farmers or gardeners would refuse an offer to insure complete protection, year after year, against insects of all sorts, for twenty-five cents an acre per annum, and we will, therefore, place the damage at one-half the above amount—ten million dollars per annum.

"Suppose that, as a consequence of this investigation, we are able to take measures which shall result in the increase, by so much as one per cent. of the efficacy of birds as an insect-police, the effect would be a diminution of the above injury to the amount of sixty-six thousand dollars per annum, equivalent to the addition of over one and a-half million dollars to the permanent value of our property; or if, as is in fact a most moderate estimate, we should succeed in increasing the efficiency of birds five per cent., we should thereby add eight and one-fourth millions dollars to the permanent wealth of the State, provided, as before, that birds do not eat unduly of beneficial species.

"These figures will be at once rejected by most naturalists as absurdly low. The young robin of Prof. Treadwell (a bird whose fame has extended over both hemispheres) required not less than sixty earth-worms a day, equivalent to at least two hundred and fifty average insects, to keep it alive. A pair of European jays have been found, Dr. Brewer informs us, to feed their brood half a million caterpillars in a season, and to eat a million of the eggs in the winter.[1]

"Compared with these numbers, my 7500 insects a year seem certainly many times too few, and similar criticisms might very probably be made on other items of the estimate. I prefer, however, to put these matters with a moderation which will command

[1] A young mocking-bird (*Mimus polyglottus*), raised from the nest by my nephew, Robert Forbes, ate about 240 red-legged grasshoppers daily, equivalent to at least 480 average insects.

general assent, especially as we see that the importance of the subject does not require exaggeration. Of course the individual farmer or gardener could, by intelligent and careful management, if he knew just what to do, increase the value of his own birds far beyond his individual share of the above-mentioned general aggregate.

"It is thus made probable that the birds intervene continuously between us and the complete destruction of our most important industries, the irretrievable financial ruin of nearly our whole population."

In conclusion, Mr. Forbes does not, with his present knowledge of economical entomology, attach any great economical value to the thrush family; it appears from his paper that they often eat many insects beneficial to agriculture, particularly ground beetles, still he would treat this question with careful conservatism, and not turn the delicate balance of nature by the extermination or undue breeding of birds.

ZOÖLOGICAL NOTES.—The study of the Siphonophores is advanced by two excellent papers by Mr. W. J. Fewkes, in the Proceedings of the Boston Society of Natural History, one on the structure of *Rhizophysa filiformis*, and the other on the tubes in the larger nectocalyx of *Abyla pentagona*, both Mediterranean forms. Mr. Tewkes has added three Siphonophores to our New England fauna.——To the same number of the Proceedings, Dr. W. K. Brooks contributes a paper on the development of the digestive tract in Mollusks.——Dr. Fritz Müller has discovered a minute Ostracod Crustacean, like Cythere, living in the tree tops of the Bromeliaceæ in Southern Brazil. It appears that these tree tops harbor a host of animals, including the larvæ of insects, even the tadpoles of treefrogs here undergoing their transformations.——The process of respiration in some Crustacea, as Astacus, certain Phyllapoda and Cladocera, has been shown to be in part carried on in the anus; in Leptodora, as shown by Weismann, this is the exclusive mode of respirations. Mr. Hartog now shows (in the *Quarterly Journal of Microscopical Science* for April) that it occurs in several Copepod Crustacea. He also describes how the Hydra swallows its prey. The part played by the tentacles ceases as soon as the mouth comes in contact with the food. The hydra then slowly stretches itself over the food and engulfs it, the tentacles usually turning away from the food.

ANTHROPOLOGY.[1]

A DICTIONARY AND GRAMMAR OF THE AIMARÁ LANGUAGE.—The literature of aboriginal languages has just been favored with an important addition in the shape of a "Dictionary and Grammar of the Aimará language," spoken in the southern portion of Peru, by the Collas (pron. Cólyas) and other tribes. This language is

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

closely related to the Kechua, or Quichua, and in our century its area is geographically surrounded on all sides by various Kechua dialects. Aimará is a highly developed language, though much less studied by scientists than the Kechua, because this had the prerogative of being the idiom of the ruling portion of the Peruvians and their Incas just previously to the Spanish conquest. Aimará has many grammatic and lexical forms more archaic than Kechua, Chancu, Atacama, and other cognate dialects, and this circumstance renders its study most useful for tracing comparisons. The work alluded to is a republication of the *Vocabulario y Arte de la Lengua Aymara*, conquesto por el *P. Ludovico Bertonio*; Leipzig, Teubner (B. G.), 1879, 8vo., 3 vols. This is a fac-simile edition of Bertonio's work, which was composed as early as 1603, the Dictionary being dated 1612; and the scientist to whom we owe the republication of this rare set of volumes is Mr. Julius Platzmann, favorably known already by his republication of ancient materials for the study of Brazilian languages and by other works of kindred import. The Aimará dictionary, consists of two parts: Spanish-Aimará, and Aimará-Spanish, each forming a separate volume; and gives the meaning of 12,000 or more terms of the language.—*A. S. Gatschet.*

ANTHROPOLOGY IN FRANCE.—The first number of *Revue d'Anthropologie* for 1880, appears promptly with the following contents:

AMEGHINO FLORENTINO.—Armes et instruments de l'homme préhistorique des Pampas, pp. 1–12, Pl. I–III.

ROYER, MME. CLEMENCE.—Le Système pileux chez l'homme et dans la série des mammifères; pp. 13–26.

BENZENGUE, DR.—Les Sourds-Muets de Moscow; pp. 27–33.

WAKE, C. STANILAND.—La barbe considérée comme caractère de Races; pp. 34–77.

Révue Critique upon Schliemann's discoveries, by M. Girard de Rialle.

Révue préhistorique, Poland, Germany, Italy, France, Portugal.

Révue des Livres: Roberts's "Manual of Anthropometry," Retzius's "Finnish Crania," Quatrefages and Hamy's "Crania Ethnica."

Révue des Journéaux. French, Italian, English, American, Russian, German.

M. Ameghino, the author of the first article, gave the readers of the *Review* a very extended account of the archæology of the pampas, in a former number (II, 2-Serie), prefacing it with a résumé of everything good and bad which he had been able to find upon the great antiquity of man in America. After giving an account of the geological formations containing relics and remains, and describing the implements met with, the author concludes with the following paragraph: "I affirm the contemporaneity of man with the great extinct *edentata* of South America, but I cannot assert that they were Tertiary. I have said that the geological age of the formation is unsolved; my impression is that it is Pliocene Tertiary."

The article of Mme Royer is designed to show that the human race is descended from a species of animals that never had any hair, in opposition to the generally received theory that our race has lost its hair in time. Following close after this comes Mr. Wake's paper upon the beard, and on pages 170-175, a review, by M. Vars, upon Ecker's "Système pileux et ses anomalies chez l'homme," so that three-fourths of the original communications of the number relate to this external characteristic. After a very extended collation of authorities who have remarked upon the abundance or scarcity of hair upon tribes in all parts of the world, Mr. Wake concludes with Peschel that the beard is a good racial characteristic, and "that there are races upon whom it is developed in all its exhuberance, while there are others in which this distinction appears to be incompletely produced." The author then goes on to seek the causes of this difference. The growth of hair upon the face cannot be attributed to such causes as alimentation and climate. Doubtless these have had their effects; but the true cause must be sought in the sum total of all the influences, moral as well as physical, to which the organism has been subjected. According to this theory, the most general and complete development of the beard should be sought among the races which have been most favorably situated or the longest exposed to the conditions favorable to its production. Beardless races, in this sense, may be compared to children, and those that are bearded to adults. If the beard be a social mark, we seem to be authorized to affirm that bearded races are more nearly related to one another than to those that are beardless.

M. Sauvage presents, on pp. 119-125, a review of parts VII and VIII of De Quatrefages and Hamy's "Crania Ethnica," relating to the Papuans, and Dr. Collineau, from p. 124 to p. 128, draws attention to an inaugural thesis of Dr. G. Calmettes "Upon the medio-frontal, or metopic suture."

The Peabody Museum receives a flattering notice, pp. 145-158, from the pen of Dr. Topinard, in which the author speaks of "the most important museum of anthropology in the United States." The work of the institution from the beginning is very well reviewed.

MR. MACLEAN'S CONTRIBUTIONS TO ARCHÆOLOGY.—We are indebted to the publishers, Robert Clarke & Co., of Cincinnati, for three archæological works by Mr. J. R. Maclean, "A Manual of the Antiquity of Man," eighth edition, 1879, "Mastodon, Mammoth and Man," second edition, 1880, and "The Mound builders." The first named volume exhibits a great deal of research and patient work on the part of the author, but we are forced, in candor, to offer a few criticisms. The authorities are not carefully selected. The main reliance are Lyell, Figuier, Buchner (Bachner?), Denton, Lubbock, Lartet, Keller, some of them very good, but Rau, Wyman, Evans, De Mortillet, Chantre

and many other later distinguished archæologists and critical historians of the East are not mentioned. The restoration of the Neanderthal man, accredited to Mr. Cushing, is evidently copied from the plaster cast in Ward's Museum, at Rochester. The well established principle of law and science that the prisoner and not the court has the benefit of the doubt, is sometimes inverted, and all doubtful cases are claimed as evidence on the author's side. Upon this point we would utter the caution that to the anthropologist the antiquity or non-antiquity of man, *an und für sich*, are alike indifferent. The truth is above all. Mr. Huxley assured his hearers at the last meeting of the British Association, that the discoveries of M. Boucher de Perthes, in the Somme valley, are not near so ancient as they are claimed to be. At the same meeting Prof. W. Boyd Dawkins read a paper on the geological evidence of the antiquity of man, of which the following is an abstract. "The evidence which geology has to offer as to the antiquity of man is as follows: In the Eocene age there were only families and orders of living Mammalia, and no living genera or species. It is, therefore, hopeless to look for man at this time in the earth's history. In the succeeding or Miocene age, living genera of mammals appear, but still no living species of Mammalia. If the flints found at Thenay, and supposed to prove the existence of Miocene man, be artificial, and be derived from a Miocene stratum, there is, to my mind, an insuperable difficulty in holding them to be the handiwork of man; seeing that no living species of quadruped was then alive, it is to me perfectly incredible that man, the most highly specialized of all, should have been living at that time. The flints shown to me in Paris by Prof. Gaudry, appear to be artificial and partly natural; some of the former from their condition, having been obviously picked up on the surface of the ground. It is less difficult to believe them to have been the work of the large extinct anthropoid apes then living in France, than to view them as the work of man. Nor in the succeeding Pliocene age is the evidence more convincing. As the evidence stands at present there is no proof, on the continent or in this country [England], of man having lived in this part of the world before the middle stage of the Pleistocene age, when most of the living Mammalia were then alive, and when mammoths, rhinoceroses, bisons, horses, Irish elks, lions, hyenas and bears haunted the neighborhood of London, and were swept down by the floods of the Thames as far as Erith and Crayford." In our own country, the occurrence of acorn mortars with crania resembling those of the modern Numas, in the Pliocene tertiary, should be vouched for by a professional archæologist, who removed them with his own hands, before any importance should be attached to them whatever. In the definitions of terms Mr. Maclean is a little unfortunate; as, *Brachycephalic*, a skull whose transverse diameter exceeds the antero-posterior diameter; *Dolico-*

cephalic, a skull whose diameter from the frontal to the occipital bone exceeds the transverse diameter.

The second named volume supplies a real need. It has been favorably reviewed before in these notes; but, since the mastodon and the mammoth are so frequently mentioned in connection with priscan man, a resumé of what is known of them in a handy manual is exceedingly timely and we repeat our praise.

Mr. Maclean's third volume, "The Mound-builders," in its first twelve chapters, reviews what has been written concerning this mysterious race, and gives the author's speculations about their earthworks, arts, civilization and antiquity. The second part, pp. 153–230, is more valuable, with all deference, than all the rest of the author's publications put together. It is a kind of work that we never weary in praising. These chapters will be quoted when all the rest is ignored. It comprises the archæology of Butler county, Ohio, with a map, giving, township by township, a complete report on a county which was one of the most important seats of the Mound-builders. Assisted by an able corps of gentlemen, the attempt was made to search out every enclosure and locate every mound. Some of these surveys are old, but many of them are for the first time made public. The author gives, on pp 229 and 230, a table of all the private archæological collections in the county, with a classified list of specimens in each.

The Protection of Antiquities.—Upon a motion made by M. Henri Martin, a member of the National Institute, the Anthropological Society of Paris, at its session of December 5, 1878, passed a resolution that a committee be nominated to wait upon the Minister of Public Instruction in order to confer with reference to the preservation of the megalithic monuments of France.

The minister, favoring the proposition, requested the Anthropological Society and the Committee upon Historic Monuments to nominate the members of the Commission. On the 21st of November, 1879, a Sub-committee was added to the Committee upon Historic Monuments with instructions to draw up an inventory of megalithic monuments and erratic inscribed boulders both in France and in Algiers. The committee consists of the following distinguished archæologists: *president*, M. Henri Martin; *vice-presidents*, M. Daubrée, director of the School of Mines, and M. de Mortillet, assistant curator of the Museum of Saint-Germain and professor in the School of Anthropology; *members*, MM. Paul Broca, director of the school of anthropology and general secretary of the Société d'Anthropologie, Emile Cartailhac, editor of "Materiaux pour l'Histoire Primitive de l'Homme," Ernest Chantre, assistant director of the Museum of Natural History, Lyons; Falsan, Leguay, Pomel, Trutat, curator of the Museum of Natural History at Toulouse; Salmond, Sommerard, curator of the Museum of Cluny; *secretary*, M. A. Violet le Duc

The committee have already commenced operations. France is divided into five sections; M. Henri Martin has charge of Brittany; M. Salmon, of the North-east, M. Chantre, of the South-east; M. Cartailhac, of the South; M. Leguay, of the Center, and M. de Mortillet of the North-west. Algeria is entrusted to M. Pomel. M. Daubrée is specially charged with carved erratic boulders; M. Falsan, with the region of the Alps, and M. Trutat with the Pyrenees.

In accordance with this scheme the inventory of monuments is rapidly progressing, and a series of questions to observers has been issued.

ANOTHER ELEPHANT PIPE.—From Prof. J. D. Putnam, secretary of the Davenport Academy of Natural Sciences, we have received photographs of three interesting pipes from Iowa, one of them representing an elephant. Mr. Putnam writes: "The elephant pipe is of especial interest as confirming the genuineness of the one previously found, being made of the same fine sandstone. It was found by the Rev. J. Gass and the Rev. A. Blumer in a mound on the farm of Mr. Hass, two miles east of Grandview, Louisa county, Iowa, in a bed of ashes, beneath a bed of hard burned clay. There were no indications of disturbance in the mound and the pipe was taken out by the gentlemen with their own hands. There is no reasonable doubt of its authenticity.

ANTHROPOLOGICAL NEWS.—Prof. Morse's Prehistoric researches in Japan are criticised by Mr. Dickins, in *Nature* of Feb. 12th, and the high antiquity of the shell-heaps seriously called in question. "Remains and traces of shell-heaps of quite modern date are common in the provinces of Musashi and Sagami, at a considerable distance from the shore." "I should hesitate to assign a higher antiquity to the Omori heaps than the thirteenth or fourteenth century, and it seems to me probable that they were the work of an Aino race."

Prof. A. R. Grote, of Buffalo, N. Y., has lately published through Asa K. Butts, an "Essay on the Bible Narrative of Creation," being a commentary on Genesis i–ii. Whatever opinion our readers may have as to the weight of authorities quoted, or concerning Prof. Grote's ability to guide us in this most intricate problem, no one will question his scientific attainments or his disposition to treat the subject fairly and his opponents kindly. The gist of the treatise is best given in the author's own words. "If there is one subject which now seems to me more important than another, it is the bearing of our recognition of the process of evolution upon the existing state of our religious creed. It is not that the teachings of Christ are to be rejected, or the morality of the Hebrew Bible to be condemned, but that we are to correct our views as to the way in which existing plants and animals (including man) came to be what they are to-day. For Astron-

omy and Geology the struggle is nearly over. Out of this struggle has sprung the fatal error of believing that our knowledge in these branches does not contradict Genesis, or that a reconciliation is possible. But with biology the struggle is now going on. It is imagined that the six days mean really periods, although from the context the meaning is shown to clearly agree with the words, since the morning and evening are given to limit the term and decide the intention. It cannot, indeed, be too often remembered that people did not write in early times what they did not mean. The study of Genesis, or the origin of things, religion must surrender to the sciences."

Société d'Anthropologie de Paris. Bureau for 1880. President, M. Ploix; vice-presidents, M. Parrot and M. Thulié; secretaries, MM. Bordier, Pozzi and Magitot; curator, M. Topinard; librarian, M. Dureau; treasurer, M. Leguay; publishing committee, MM. de Ranse, Bataillard, Dally.

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GEOLOGY AND PALÆONTOLOGY.

ARTIFICIAL FORMATION OF THE DIAMOND.—Great interest has been excited in England during the last few months, by several reports of the artificial manufacture of the diamond. The earlier reports appear to have been founded in error, but success seems

at length to have attended the labors of Mr. Hannay, of Glasgow. The method adopted, is by taking advantage of the affinity displayed by hydrogen for certain metals, especially magnesium, at a very high temperature, forming extremely stable compounds with them. When carbon is by this means set free from a hydrocarbon in presence of a stable compound, containing nitrogen, the whole being near a red heat and under a very high pressure, the carbon is so acted on by the nitrogen compound, that it is obtained in the clear transparent form of the diamond. The carbon thus obtained is as hard as natural diamond, with a specific gravity, ranging as high as 3. 5, scratching all other crystals, and it does not effect polarized light. Mr. Hannay obtained crystals with curved faces belonging to the octohedral form, the diamond being the only substance that crystallizes in this manner. The crystals burn easily on thin platinum foil, over a good blowpipe and leave no residue, and after two days immersion in hydrofluoric acid, they show no signs of dissolving, even when boiled. On heating a splinter in the electric arc, they burn black, a very characteristic reaction of the diamond. At a recent meeting of the Royal Society, where a brief account of Mr. Hannay's discovery was read, Mr. N. S. Maskelyne, F.R.S., the keeper of the mineralogical collection at the British Museum, confirmed the statements that the crystals sent to him by Mr. Hannay, possessed all the properties of the diamond. Mr. Hannay has written to the London papers, to allay the fears of diamond merchants as to a possible heavy fall in the value of diamonds, stating that the cost of the process is so great that it will probably never amount to more than a laboratory experiment. The great difficulty lies in the construction of an inclosing vessel, strong enough to withstand the enormous pressure and high temperature, tubes constructed on the gun-barrel principle, with a wrought iron coil, of only half an inch bore, and four inches external diameter, being torn open in nine cases out of ten.—*A. W. Bennett.*

Corrections of the Geological Maps of Oregon.—In the existing Geological maps of Oregon, the Coast range is represented as composed of Archæan rocks. This is a serious error, Prof. Newberry has already stated (U. S. Pac. R. R. Surveys, Vol. vi, pt. ii, p. 29), that the fossils of the range are of an age not older than the Miocene. The unpublished notes of Prof. Condon, formerly State Geologist, state that the back bone of the Coast range consists of argillaceous shales, which contain invertebrate and vertebrate fossils, frequently in concretions. Some of the latter are Physoclystous fishes, with strongly ctenoid scales. To this formation, Dr. Condon gives the name of Astoria shales. Above this is an extensive tertiary deposit, rich in Mollusca, which is usually interrupted by the central elevations of the mountain axis. Prof. Condon refers this to an Upper Miocene age, under the name of the Solen beds. On the flanks of the mountains,

this is overlaid by a pliocene formation, containing some of the fossils of the Equus beds of central Oregon. This is both underlaid and overlaid by basalt, and other volcanic products.

The regions of the John Day river and Blue mountains, furnish sections of the formations of Central Oregon. Above the Loup Fork or Upper Miocene, there is a lava outflow, which has furnished the materials of a later lacustrine formation, which contains many vegetable remains. The material is coarse, and sometimes gravelly, and it is found on the Columbia river, and I think also in the interior basin. Prof. Condon calls this the Dalles group. It is in turn overlaid by the beds of the second great volcanic outflow. Below the Loup Fork follows the Truckee group, so rich in extinct mammalia, and below this a formation of shales. These are composed of fine material, and vary in color, from a white to a pale brown and reddish-brown. They contain vegetable remains in excellent preservation, and undeterminable fishes. The *Taxodium* nearly resembles that from the shales at Osino, Nevada, and on various grounds I suspect that these beds form a part of the "Amyzon group" (this Journal, 1879, p. 332), with the shales of Osino and of the South park of Colorado. Below these, is a system of fine grained, sometimes shaly rocks of delicate, gray buff and greenish colors, containing calamites, which Prof. Condon calls the *Calamite* beds. Their age is undetermined.—*E. D. Cope.*

GEOGRAPHY AND TRAVELS.[1]

ARCTIC VOYAGES.—The east coast of Greenland from 69° N. lat. to 65° 18′ has never been laid down until the past summer, when the Danish man-of-war steamer *Ingolf*, reached that part of the coast, sailing from Iceland. Having fixed the positions of some high lands south of Scoresby land, the Danish Hydrographic office has been able partly to fill up this blank on their maps.

It was also found that the ice cold water of the sea bottom, never passes the submarine heights stretching from the Faroe islands to Iceland, and that the depth of the sea decreases considerably in about N. lat. 67°, where it varied from 150 to 200 fathoms, and large icebergs were met with.

Further to the eastward, the temperature of the deeper water rose gradually, while on the surface the rise was sudden—in one case from 1° to 7° C. [33°. 8 to 44°. 6 F.] in an hour; in a distance of five miles the depth of the sea increased from 160 to 505 fathoms and in the Gulf stream to 1005 fathoms.

An immense bank was discovered, running from the north-west coast of Iceland, almost to the Greenland coast, and helping to keep the cold polar streams from the Atlantic.

M. Kornerup, a member of the recent Danish expedition into

[1] Edited by ELLIS H. YARNALL, Philadelphia.

the interior of Greenland, mentioned in the NATURALIST for April, states, that in the course of his explorations in the ice fields of the interior, he ascended a hill, the top of which was covered with flowers, and vegetation; several kinds of small animals being also found there.

We learn from the *Proceedings of the Royal Geographical Society*, for February, 1880, that a Norwegian Captain Kjelsen, attained a very high latitude on the Spitzbergen meridian last year, sailing, about the 12th of September, sixty nautical miles northward from the Seven islands. No ice could be seen, nor any ice blink on the northern horizon. The latitude is not given, but could not have been far short of that reached by the Swedes in 1868, 81° 42′ N., and may possibly have exceeded it.

While the Arctic sea was thus unusually open to the north of Novaya Zemlya and Spitzbergen, the Sea of Kara was full of ice throughout the season, and only one vessel finally succeded in penetrating it, and made the voyage out and back from Bremen to Yeniseisk.

The Russian government established, in 1878, Karmahul harbor [72° 30′ N. lat.] in Möller bay, Novaya Zemlya, a station for the relief of ship-wrecked sailors and also directed the taking of a series of meteorological observations for a whole year. Lieut. Tiaguine was placed in command, and with his wife, children, three servants and five Samoyede families, passed the winter of 1878–9 on the island. The autumn was rainy and cold. The average temperature was about 39° .20 F. The first frost was on September 26, the first snow, on September 28, and the sea froze on October 10. Drift ice was seen in the middle of October, and on November 13, the harbor and small bays were frozen over. Möller bay, however, did not freeze during the whole winter, except among the islands. The first thaw happened in the middle of May, and by June 14 the small islands were covered with verdure, but the harbor was not clear of ice until July 16. The mean temperatures were November, 49° .64 (F.) February, 0° .04, March, 10° .76. During the five winter months, the mean temperature was 10° .04. The wind varied considerably, sometimes rising to violent storms from E. S. E. A small quantity of snow fell, but was blown into deep drifts. Three of the Samoyedes died from scurvy, having refused to take exercise, or follow Lieut. Tiaguine's recommendations. The rest returned well to Archangel in August, 1879. Lieut. Tiaguine considers wintering in Novaya Zemlya quite practicable, but a supply of provisions is absolutely necessary, as it seems impossible to obtain by hunting, anything like a sufficient quantity of animal food during the winter.

A New edition of the "Narrative of the North Polar Expedition,"—the voyage of the *Polaris*, under Capt. Hall, has been authorized by Congress, provided the number of subscribers shall reach 500. Orders may be sent to Mr. A. F. Childs, Government

Printing Office, accompanied by the price of the volume, $2. This is likely to be the last opportunity of obtaining the volume.

It is also to be hoped that another edition of the narrative of the second Arctic Expedition made by Capt. Hall [reviewed in our last number], to be sold at cost price, will also be ordered. The demand for it has been very great, and the first edition was very quickly exhausted.

An Italian Antarctic Expedition is proposed by Lieut. Bove, who was one of the officers under Nordenskiöld on the *Vega*. It is to sail in the spring of 1881 and touch at Monte Video, Terra del Fuego, Falkland and South Shetland islands, and proceeding in a south westwardly direction, commence explorations, expecting to be engaged for two winters in the Antarctic region, and return by way of Hobart Town. The expenses are estimated at 600,000 lire.

THE HOWGATE ARCTIC EXPEDITION.—The following bill has passed the U. S. House of Representatives, and been favorably reported to the Senate:

A BILL to authorize and equip an expedition to the Arctic Seas.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the President of the United States be, and he hereby is, authorized to establish a temporary station at some point north of the eighty-first degree of north latitude, on or near the shore of Lady Franklin Bay, for the purposes of scientific observation and exploration, and to develop or discover new whaling-grounds; to detail such officers or other persons of the public service to take part in the same as may be necessary, and who are willing to enlist for such purpose, not exceeding fifty in number, and to use any public vessel or vessels that may be suitable for the purpose of transporting the members of said station and their necessary supplies, and for such other duty in connection with said station as may be required from time to time: *Provided*, That the President of the United States is authorized to accept from H. W. Howgate, and fit out for the purposes of this expedition, the steamship *Gulnare*, which vessel shall be returned to its owner when the objects of the expedition shall have been accomplished, or when, in the opinion of the President, its services are no longer required: *Provided further*, That the United States shall not be liable to any claim for compensation in case of loss, damage, or deterioration of said vessel from any cause, or in any manner whatever, nor be liable to any demand for the use or risk of said vessel.

We learn from Capt. W. H. Howgate, that the steamer *Gulnare* is of about 230 tons burden, and will have a crew of fifteen, officers and men all told. The expeditionary party which will be left at the station while the vessel returns to the United States, will consist of twenty-five men, including the necessary scientific corps.

It is hoped that the exploring party can be landed at some point on or near the shore of Lady Franklin Bay in time for the *Gulnare* to return home this season. The *Gulnare* is being fitted up for ice navigation under the superintendence of Capt. Chester, who was with Hall in the *Polaris*. A house of wood, double boarded, 21 x 68 feet, modeled after those used by the Hudson's Bay Company, is being constructed for the men to winter in on the shores of Discovery harbor. A steam launch will probably form part of the expedition. The purposes and intentions of this new attempt at Polar discovery are given in the report of the House Committee as follows:

"In making this report the committee respectfully state and report that the object of the bill, as is shown by its terms, is to authorize a temporary station to be selected within the Arctic circle, for the purpose of making scientific discoveries, explorations, and observations, obtaining all possible facts and knowledge in relation to the magnetic currents of the earth, the influence of ice-floes therefrom upon the winds and seasons, and upon the currents of the ocean, as well as other matters incidental thereto, developing and discovering at the same time other and new whale-fisheries, now so material in many respects to this country. It is, again, the object of this bill that this expedition, having such scientific observations in view, shall be regularly made for a series of years, under such restrictions of military discipline as will insure regularity and accuracy, and give the fullest possible return for the necessary expenditure; and, again, in view of the fact that either the governments directly, or scientific corps under their authority, of Germany, Holland, Norway, Sweden, Austria, Denmark, and Russia, have concurrently agreed to establish similar stations, with like object, during the year 1880, it is believed that the interests and policy of our people concur in demanding that the United States should coöperate in the grand efforts to be thus made in the solution of the mysteries and secrets of the North Polar seas, upon which, in the opinion of scientists, depends so much that affects the health and wealth of the human race."

MICROSCOPY.[1]

ADULTERATIONS OF FOOD.—Adulterations or impurities of food may be divided into three classes. First, deleterious adulterations; these are such as are directly injurious to health, such as red lead in cayenne pepper, chromate of lead in mustard, or water in milk. The second class, and by far the largest, is what may be called fraudulent adulterations. These injure the pocket rather than the health. This class does not properly come under the notice of the health officer, but is a fraud upon the general public, which should be taken notice of by mercantile associations. This

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

class may be illustrated by such articles as flour in mustard, chicory in coffee and terra alba in cream of tartar. The third class is what may be called accidental. In many instances of this class, it is the duty of the health officer to interfere and confiscate the goods, but the simple deprivation of the articles is generally sufficient punishment. In other cases, in this class, the presence of the impurity arises from methods of manufacture, and if it does not exceed a certain limited amount it may be neglected, and is generally neglected in trade. For instance, cream of tartar generally contains tartrate of calcium; if this does not exceed six or seven per cent. the article passes as pure. If it runs much higher the article is rejected or passes as a low grade with a reduction in price. Belonging to the same class is the small amount of sand oftentimes found in Cuban sugars, and in general all the impurities in our every-day food which are present, not from design, but from some imperfection in the process of manufacture.

The first operation in our search for adulteration is to make ourselves thoroughly acquainted with the genuine article, and in order to make ourselves acquainted it is not sufficient to merely read the accounts we may find in the books, but we must take the articles to our laboratories and submit them to every test that we can devise. Perhaps the most difficult branch of adulteration that the chemist has to deal with is the sophistication of ground articles. So long as the article is in its natural state but little trouble is experienced; we can readily detect any changes made in it, but when ground we have no resource except the microscope or chemical tests. Many substances which contain starch grains can be readily recognized by the microscope. Flour in mustard at once shows. The various arrowroots are readily distinguished by this means. A few weeks ago I had occasion to examine flour that was suspected of adulteration. Washing with water served to show that one portion was much heavier than the remainder. Microscopic tests at once showed that this heavier portion was rice flour. In this case the usual order of adulteration was reversed, and a more expensive article was added to a cheaper one in order to raise the grade of the whole. Much has been said and written in regard to the adulteration of coffee, but so far as I know no one has yet found in the coffee any article more injurious than the coffee itself. Chicory may be readily distinguished from coffee by the fact that when the ground article is thrown into water, if chicory, peas, rye or Indian corn are present, they rapidly sink to the bottom, while the coffee floats. The adulterations also quickly impart to cold water a brown color, while coffee colors it but slowly. Cream of tartar is, perhaps, the substance next on the list at present which gives us the most trouble. The common adulterations of this article are rice flour, which is easily detected by the microscope and by turning blue when treated with tincture of iodine. Terra alba or

gypsum, which is but sparingly soluble in hot water, but which may be dissolved with muriatic acid; when this is present the solution gives a precipitate with chloride of barium. It is also readily recognized by the microscope when polarized light is used. Tartrate of calcium—this is almost insoluble in boiling water—is soluble easily in hydrochloric acid, and gives a precipitate with ammonia and oxalate of ammonia. The quantity of this must exceed seven or eight per cent. before it can be reckoned as an adulterant. Milk is another subject about which the controversy seems to be needless. The list of adulterations found in the books is a long one, but when thoroughly investigated, it seems to narrow down to about two or three. Water is added in considerable quantities, a little burnt sugar is then added to bring up the color. One or two other substances are sometimes classed as adulterants, the use of which can hardly be condemned. In hot weather many of the milkmen add a little baking powder or bicarbonate of soda to the milk, or a little salt; both these substances tend to prevent the milk becoming sour and coagulating. A trace of chalk is also sometimes used for the same purpose. The fraud most extensively practiced in this vicinity at the present time is the sale of skimmed for whole milk. This fraud can easily be detected by the microscope. Milk that has been skimmed is comparatively free from large fat globules. Sugar as sold here is perhaps as pure as sold at any place in the world. Candy, however, is like all manufactured articles, to be looked upon with suspicion. The flavoring matters are rarely what they purport to be, and in some cases are violent poisons. At the present time the article is made largely of glucose, which is manufactured from corn starch. I see no objection to the use of this, provided it is well made and purified. In the examination of meat the inspector has to rely largely on his senses and his familiarity with the genuine article. The microscope comes in play here to detect certain diseased conditions, and to show encysted parasites, such as *Trichina spiralis*.

Avoid hasty conclusions about adulteration. Persons often take a look through their microscopes at articles of food and rush into print their discoveries, when a few hours' patient investigation of genuine articles about which there could be no doubt, will serve to show them that they were mistaken in their suppositions. Young students fresh from college are apt to find things very much worse than those who have studied the subject for years. But I would not for this reason discourage a full investigation of the subject. The more thoroughly we become acquainted with it, the better able we will be to detect and secure the punishment of fraud where it does occur.—*Read before the Boston Microscopical Society, by S. P. Sharples, State Assayer of Massachusetts.*

A NEW "GROWING SLIDE" FOR MINUTE ORGANISMS. — Mr. Julien Deby, vice-president of the Belgian Microscopical Societ

submitted to the Queckett Club a description of a newly contrived growing slide which is easily made, and which answers its purpose remarkably well. A glass ring is cemented to a 3×1 slip, forming a cell one-eighth of an inch deep and three-quarters of an inch in diameter, as if for mounting an object. A small hole is bored through the slip inside of this cell, and near its edge. The objects (as Bacteria, &c.) are placed in a very minute drop of water upon a thin cover-glass which is then inverted upon the cell and attached to its ring by a little lard, the drop with its objects being within the cell but touching only the cover-glass. Another 3×1 slip is then placed below the perforated one and attached to it by india rubber bands passed around the ends. One end of the whole combination is then placed in a little water which spreads between the slips by capillary attraction, and by evaporation passes through the hole into the cell, and prevents the drop of water at the top of the cell from drying up. A small fraction of a drop of water may thus be maintained without serious loss for weeks together, the objects it contains being meanwhile in a most favorable position for microscopical study. Mr. T. C. White reminded the members that it was easy to drill the hole through the glass slip by using a steel drill ground to a three-sided point and well hardened by heating and then dipping in turpentine. The hole should be bored half way through from one side, and then from the other, and then cleared out with a small file.

Collecting and Mounting Spiders' Webs.—In an interesting paper on this subject read before the Queckett Club, Mr. Geo. Hind states "that he found it unsatisfactory to take the web directly upon the glass slide, it being difficult to secure the desired portion of the web or to free it from the moisture that is present. He prefers to take pieces of wire about twelve inches long, bent into rectangular frames and gummed to secure adhesion of the web. This frame is carefully brought up against the selected portion of the web, which adheres, and the surrounding portion of web is cut away with a pair of scissors. The frame with its adherent web is then placed in a racked box until the web and any insects it may contain are perfectly dry. When ready for mounting, a thin paper cell is fastened to a glass slip, and its upper surface slightly gummed and brought in contact with the web. The surrounding web is cut away with scissors, another thin paper cell is placed above the first, the web being thus left stretched between them, and a cover-glass affixed in the usual way. In this manner may be obtained many small insects that are with difficulty found in any other way. Finding that several spiders that were kept in confinement in order to obtain good threads for mounting, would not at first spin threads, and being unwilling to wait for them to commence, the author occasionally shook the spider to make it spin stray threads, and in so doing

discovered the reason why the web is plain in some parts and beaded in others, the radial threads being continuous while those which form the concentric circles are beautifully beaded. "When emitted by the spider, the web is in a very viscid state, and I noticed that when the whole weight of the spider was upon the web, and the thread was fastened off quickly, it was not beaded; but when by some chance the spider had slightly relaxed the tension before fastening it off, I observed a slight quiver pass through the thread, and upon examining it with a magnifier, I found that it was beaded from end to end.

WOOD-FIBRES FOR PAPER-MAKING.—Mr. Galloway C. Morris has contributed to the Postal Club a special box of wood fibres prepared in a form suitable for paper pulp. They were prepared by boiling under pressure in caustic alkali in order to destroy everything but the cellulose, and the peculiar wood fibres of the plants selected are completely isolated and well shown. Not only do the preparations show soft woods such as poplar, pine and buckwheat, but also such harder woods as hickory, rosewood and ebony.

CLEANING COVER-GLASSES.—Dr. R. U. Piper, of Chicago, has invented a very simple method of cleaning cover-glasses without breaking them. Upon a glass plate 2×3 inches are cemented, in the form of a V, two thin strips of glass. A cover-glass may be laid upon the glass plate inside of the V and cleaned by rubbing freely, being held in position from slipping by the sides of the V.

SPODUMENE.—An excellent paper on this subject, reprinted from the Annals of the New York Academy of Sciences, by Alexis A. Julien, contains interesting discussions of the microscopical characteristics of this mineral and its alterations. They can be satisfactorily studied only in connection with the accompanying plate.

THE MICROSCOPICAL APPEARANCES OF THE VALVES OF DIATOMS.—In a paper on this subject, reprinted from the Annals of the Belgian Microscopical Society, Mr. Julien Deby, vice-president of the society, gives a very interesting study, accompanied by diagrammatic illustrations, of the proper interpretation, in respect to their physical structure, of the microscopical appearances of some of the more puzzling species of diatoms.

THE AMERICAN JOURNAL OF MICROSCOPY. — This monthly, whose publication was temporarily delayed during a considerable portion of last year, has now been brought up to date, and the current numbers are being issued regularly and promptly. Last year's numbers, Vol. IV, have been issued as a bound volume, and constitute, at a slight cost, a book full of interesting glimpses of the daily progress of this branch of science.

SCIENTIFIC NEWS.

— The eleventh number of the Bibliographical Contribution of the Library of Harvard University is on the entomological libraries of the United States, by Mr. S. H. Scudder. The largest is that of the Zoölogical Museum at Cambridge, numbering about 2000 volumes and 3000 pamphlets; the Public Library of Boston contains about 650 volumes and 75 pamphlets, that of the Boston Society of Natural History 900 volumes and nearly 550 pamphlets; that of the American Entomological Society at Philadelphia, 1728 volumes and 336 pamphlets; of the Academy of Natural Sciences at Philadelphia, 956 volumes and 554 pamphlets; of private libraries, that of Mr. Scudder comprises 765 volumes and very nearly 2000 pamphlets; Prof. C. V. Riley's about 700 volumes and about 3000 pamphlets; Dr. J. L. LeConte's about 700 volumes and 800 pamphlets; Prof. A. S. Packard's 470 volumes and 550 pamphlets; and Mr. P. R. Uhler's contains over 300 volumes and about 500 pamphlets; while the library of the Peabody Institute at Baltimore, contains 800 volumes and 200 pamphlets. Important libraries of entomological works are possessed by the Buffalo Society of Natural Sciences; the Congressional Library, the Entomological Division of the Agricultural Department, at Washington, the Astor Library, and that of Yale College.

— Jacob Stauffer died in Lancaster, Penna., on March 22d, in the seventy-second year of his age. Mr. Stauffer was a naturalist by instinct, and a man of various natural gifts. He was born in Lancaster county, Penna., and received a common school education. He followed various avocations, but devoted a good deal of time to natural history. He was a good local botanist, and early made some important observations on the parasitism of certain species of our native *Scrophulariaceæ*. He discovered several new species of fishes; one a percoid, the *Etheostoma peltatum* Stauffer; another, the singular blind catfish, *Gronias nigrilabris*. His most extended studies were made in entomology, and his innumerable observations on the habits and metamorphoses of insects were recorded in large manuscript books, illustrated with numerous colored drawings executed by himself. It is to be hoped that these may be in some way rendered available to science by some competent entomologist. Mr. Stauffer was a man of much native refinement, and both amiable in his manners and just in his dealings. His name is recorded in the fauna of Mexico in a species of tree-frog, *Hyla staufferi* Cope.

— The Diary of a Bird, freely translated into human language, by H. D. Minot, published by A. Williams & Co., Boston, 1880, is very well done. The complaints that avian flesh is heir to from the attacks of their historian, if not always true friend, man, culminate in the following statistics on page 33: In the State of

Massachusetts alone there are annually destroyed not less than 50,000 partridges, 30,000 woodcock, 15,000 quail, and 5000 snipe, or 100,000 game birds, while in the same State 250,000 wild birds (counting their eggs) are placed *hors du combat.* Mr. Minot says that we must not be surprised if no less than 1,000,000,000 wild birds are annually destroyed in the United States. *Hine illæ lachymæ*, so far as regards the diary of this bird, which if it may seem in some degree to stay this unseemly carnage has not been written in vain.

— One of the reports of the *Challenger* Expedition has at last been issued, and will form the specimen to which the other reporters will model their memoirs. The work will make altogether some fourteen or fifteen quarto volumes, illustrated by lithographed plates. The section intrusted to the care of Prof. Haeckel—the Radiolaria—proves to be of greater importance than was suspected, for the reporter finds himself called upon to deal with more than 2000 new species, and to constitute a new order of hitherto unclassified forms. Only 750 copies of the work are to be printed, and of these 350 will be issued to the public, leaving 400 to be distributed by the Government The volumes will make their appearance now as rapidly as possible, as many are already in the hands of the printer.

— Congress is showing a commendable disposition to protect some of the great natural curiosities of the country against desecration or destruction. The Yellowstone Park,through the exertions of Dr. Hayden, was set aside forever as a public reserve. The project of preserving Niagara Falls by constituting the lands around them an international park has not yet been completed, but it is under consideration; and the House of Representatives passed, in January, a bill reserving from sale or other disposition the lands on which the "Big Trees" of California stand. The reservation is to be dedicated to the people, and set apart as a public park.

— According to an American journal, cabbage grew wild in Siberia; celery originated in Germany; the potato is a native of Peru; the onion originated in Egypt; tobacco is a native of South America; millet was first discovered in India; the nettle is a native of Europe; the citron is a native of Asia; oats originated in North Africa; rye came originally from Siberia; parsley was first discovered in Sardinia; the parsnip is a native of Arabia; the sunflower was brought from Peru; spinach was first cultivated in Arabia; the horse-chestnut is a native of Thibet; the quince came from the island of Crete; the pear is supposed to be of Egyptian origin; the horse-radish came from the South of Europe.

— The Annual Report of the Entomological Society of the Province of Ontario, Canada, for 1879, is quite fully illustrated,

and contains numerous articles on applied entomology, and a good deal of matter of general entomological interest.—In the Transactions of the California State Agricultural Society for 1879, appears an article entitled, The Rocky Mountain Locusts, their destructive power, how they eat, and breed, and bring ruin, by J. G. Lemmon; it contains a number of new facts regarding the native destructive California locusts, notably *Œdipoda atrox*, which was locally destructive in 1877, '78 and '79.

— One curious effect of the eclipse in California on Sunday, January 11, 1880, about the time of the greatest obscuration, was the bewilderment of the wild game on the bay. Flocks of ducks flew into the ferry slips, thoroughly disorganized. Another strange result was that, as the darkness increased, a valuable horse belonging to a gentleman at Alameda Point showed signs of great alarm which developed into madness as the gloom increased; he bit and kicked at all who came near, rushed through a fence and the side of a barn, and had to be shot.—*San Francisco Call.*

— By the recent death of Snellen Van Vollenhoven, Holland has lost its most distinguished entomologist. Kiesenwetter, well known as a coleopterist, has also died. We failed to record the death of W. P. Schimper, March 20th. He was distinguished as a botanist and palæontologist, holding at the time of his death the professorship of geology and mineralogy in the University of Strasburg. John Carey, well known to American botanists, died near London, March 26, and W. E. Austin died in Closter, N. J., March 18, aged 49. His specialty was mosses, and he had in preparation a manual of N. A. Hepatic mosses.

— A work by Keyserling on the spiders of North and South America is announced to be published in Nürnberg. It is a pity that a work of this sort should not be prepared by an American, who can study the spiders alive, become familiar with their young stages and with the variation of the species. A set of alcoholic specimens picked up here and there by mere collectors is apt to lead to the multiplication of "species," and to long synonymical lists. The work announced treats of the laterigrade spiders, will have eight partly colored plates and will cost 40 marks.

— Dr. August Weismann's studies in the Theory of Descent, with a prefatory notice by Charles Darwin, translated and edited, with notes, by Raphael Meldola, will be published by Messrs. Sampson, Low, etc., in three parts. The first will be on the Seasonal Dimorphism of Butterflies. Part II on the Origin of the Markings of Caterpillars and on Phyletic Parallelism in Metamorphic Species, and Part III on the transformation of the "Mexican" Axolotl into Amblystoma and on the Mechanical Conception of Nature.

— Mr. Julius Bien announces that he will publish a new Geological Map of the United States, by Prof. C. H. Hitchcock, provided a sufficient number of subscribers can be obtained to cover the expense. The base is the United States Centennial Map, revised and completed by order of Congress. It is 8x13 feet, and will be furnished with the geological colors, mounted on rollers, at $50, or in 16 sheets at $45 per copy. Explanatory text will accompany the map.

— The death of the distinguished geologist and mineralogist, Professor Karl von Seebach, is announced as having taken place on the 21st ult., at Göttingen, in the university of which town he held a chair. He was born at Weimar, in 1829, and has therefore died in the prime of life. The author of numerous works on geology and mineralogy, it is chiefly by his investigations into the causes of volcanoes and earthquakes that Seebach will be remembered.

— In the *Comptes Rendus* for February 9th, M. Pasteur describes the virulent maladies of fowls. He states that the cholera of fowls may be prevented from becoming fatal by inoculation. M. Pasteur suggests that we should seek the destruction of phylloxera by inoculation of the vine with some microscopic fungus, and he invites the attention of naturalists and others interested in the cultivation of the vine to the subject.—*English Mechanic.*

— The Chicago *Field* is publishing a series of articles by Mr. W. H. Ballou, on the bibliography of American naturalists; it begins with a list of the writings of Prof. A. S. Packard, Jr., and Dr. Elliott Coues, and will include similar bibliographical lists of other naturalists. Should it result in a bibliographical manual of American zoölogists, the undertaking will prove of very considerable advantage to students.

— A good deal of new light has been lately thrown on the nature of the Indian poison, curare. The plants which yield it all belong to the genus *Strychnos.* M. Planchon distinguishes four regions as centres of preparation of curare, for each of which a principal plant may be indicated. These are English Guiana, the region of the Upper Amazon, the region of the Rio Negro, and Upper French Guiana.

— The season of summer schools of Science has come. The Chesapeake Zoölogical Laboratory, directed by Prof. W. K. Brooks, under the auspices of the Johns Hopkins University, began its third session, at Beaufort, N. C., April 22d, and will remain open until September 1st. The laboratory will accommodate six persons, and will be equipped with boats, nets, dredges, aquaria, microscopes, &c. Application for admission may be made to Prof. W. K. Brooks, Beaufort, N. C.

— The fifth session of the Summer School of Biology of the

Peabody Academy, at Salem, Mass., will be opened July 6th, under the direction of Prof. E. S. Morse, aided by Profs. G. L. Goodale, H. G. Straight, Dr. C. S. Minot, and Mr. John Robinson, John Sears and Charles Fish. The course is solely for teachers, and will be elementary in its character.

— A new Summer School of Biology. Professors Shepard and Ford announce their intention of establishing a Summer School of Biology at Drury College, Springfield, Mo., beginning July 1st, and continuing at least six weeks. Prof. Shepard studied for a time under Prof. Packard, while Prof. Ford was a student of Prof. Peck, the N. Y. State botanist.

— At the meeting of the Sixth Congress of Russian Naturalists, Prof. Andreieff spoke of the necessity of giving instruction in natural sciences in primary schools; and M. Gerd gave an address on the impulse which could be given to the study of nature in Russia, its flora and fauna, by the teachers of the primary schools.

— The Michigan State Pomological Society has, at the suggestion of Prof. A. J. Cook, offered two prizes, the first of fifty dollars, and the second of twenty-five, to be given to the neighborhood that shows most skill, thoroughness and secures best results in destroying the coddling moth.

— The Japanese Government are about to establish a Geological Staff, to whose care will be committed a geological survey of the whole of Japan, founded upon the plan of the Geological Survey of the United Kingdom.

— The second edition of V. Rattan's popular Botany of California has been recently published by A. L. Bancroft & Co., San Francisco.

— Mr. Charles C. Frost, the noted shoemaker botanist of Brattleboro, Vt., died last week aged seventy-five years.

— Prof. Thomas Bell, the well-known English naturalist, lately died aged eighty-seven.

— The following errata occur in the March number: p. 161, line four and ten, for *opademe* read *apodeme;* line eleven for *samite* read *somite.* In the April number, p. 247, line 11, and in explanation of Fig. 14, for moth, *read* butterfly.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

NATIONAL ACADEMY OF SCIENCES, Washington, D. C., April 20, 1880.—The following papers were read: 1. Binocular Vision; Laws of Ocular Motion, by Joseph LeConte; 2. Hollow Water-Spouts and Sand-Spouts, by W. Ferrel; 3. On the Structure

of the Vertebrata of the Permian Period, by E. D. Cope; 4. On the Perforations of the Squamosal Bone of the Mammalia, by E. D. Cope; 5. Contributions to Meteorology, by Elias Loomis; 6. On the Structure of the Brain of *Limulus polyphemus*, by A. S. Packard, Jr.; 7. On an Instrument for Measuring Radiant Heat, by S. P. Langley; 8. On the Composition of Colors, by S. P. Langley; 9. The Sea Urchins of the *Challenger* Expedition, by Alexander Agassiz; 10. Size of the Brain in Extinct Animals, by O. C. Marsh; 11. On New Complex Inorganic Acids, by W. Gibbs; 12. On the Taconic System in Geology, by T. Sterry Hunt; 13. On the Telegraphic Determinations of Longitude by the U. S. Hydrographic Office, by Capt. F. M. Green, U. S. N.; 14. On the Announcement of the Discoveries of Intra-mercurial Planets by Telegraph, by D. P. Todd; 15. On the Nebula of Orion, by Prof. E. S. Holden; 16. On the Distribution of the *Zenopsis conchifera*, by Theo. N. Gill; 17. Revision of the Atomic Weight of Antimony, by Josiah P. Cooke; 18. On an Early Race of Man in Japan, by Edw. S. Morse; 19. Revision of Atomic Weight of Antimony, by Josiah P. Cooke; 20. Cloudbursts, by Wm. Ferrel; 21. On the effect of railroad trains in transmiting vibrations through the ground as regards its effects on observations in fixed observatories, by H. M. Paul; 22. On the modifications suffered by Light on passing through a very narrow slit, by Lieut. Albert A. Michelson; 23. Some remarks on the supposed nature of the Sun's Corona; and also, on a supposed new Meteoric Silicate, by J. Lawrence Smith; 24. On some modern developments bearing upon the Nebular Hypothesis and other matters connected therewith, as well as on some previous changes, and miscellaneous notices, by Stephen Alexander. The attendance was full. A eulogy of the late Prof. Henry, by Prof. Newcomb, was read by Dr. Coues. Prof. W. H. Brewer and Major J. W. Powell were elected members.

New York Academy of Sciences, March 15.—Prof. Thomas Egleston spoke concerning the iron and coal resources of Virginia.

March 29.—Mr. J. M. Batchelder noticed the influence of electricity upon the growth of plants, and the Algæ of New York harbor were remarked upon by Mr. B. B. Chamberlin.

Aoril 19.—Mr I. C. Russell gave an account of recent observations on the geology of Hudson county, N. J. Dr. J. S. Newberry remarked on the vegetation of the vicinity of New York in the Triassic age. Mr. B. Hitchcock read a paper on the physics of vision with the compound microscope.

May 3.—Prof. G. Macloskie made a communication on the structure of the vertebrate skull.

Boston Society of Natural History. April 7.—Mr. S. H. Scudder described the Devonian insects and their rel

doctrine of descent. Mr. W. O. Crosby remarked on the age and succession of the crystalline rocks of Guiana and Brazil.

April 21.—Mr. W. O. Crosby concluded his remarks on the age and succession of the crystalline rocks of Guiana and Brazil. Mr. E. Burgess read a paper on the structure of the mouth-organs of Butterflies, and some other points in their anatomy.

May 5.—Annual meeting for the election of officers and for the presentation of the reports of the custodian, secretary, etc. Mr. S. H. Scudder was elected president. Dr. B. J. Jeffries remarked on the present position of the question of the development of the color-sense.

American Geographical Society, New York, April 26.—A paper on Japan as it is, was read by Rev. Edward W. Lyle.

California Academy of Sciences, April 5.—Mr. B. B. Redding exhibited a very artistically constructed fishing fly, manufactured and used by the Indians. The Indians, he said, will beat us in fishing. By the same gentleman, twigs of the *Larrea mexicana*, with the lac insect imbedded, were shown. These he had procured from Arizona since Prof. Silliman read a paper on the subject. He expressed a doubt about there being a sufficient quantity to make the extraction of the shellac and lac-dye a profitable industry, though the process is very simple.

[Note.—We have just received a paper on this lac from Mr. R. E. C. Stearns, for early publication.—*Editors.*]

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

American Journal of Science and Arts.—May. Outlet of Lake Bonneville, by G. K. Gilbert. Chemical and geological relations of the atmosphere, by T. Sterry Hunt. Archæan rocks of Wasatch mountains, by A. Geikie. The sternum in Dinosaurian reptiles, by O. C. Marsh.

Psyche.—March. Contains a valuable résumé of advances in the anatomy of insects during 1878 and 1879, by E. Burgess.

The Geological Magazine.—April. Note on the geographical distribution of volcanoes, by. J. Milne.

Nature.—April. Mr. H. N. Moseley is publishing in *Nature*, for this month, a valuable lecture on deep sea dredging and life in the deep sea.

Quarterly Journal of Microscopical Science.—April. The coffee leaf disease of Ceylon, by W. T. Thiselton Dyer. Development of the kidney in its relation to the Wolffian body in the chick, by A. Sedgwick. Notes on the development of Araneina, by F. M. Balfour. Some teachings of development, by E. Schäfer. On the histology of Hydra, by T. J. Packer. The Orthonectida, a new class of the phylum of worms, by A. Giard.

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THE USE OF AGRICULTURAL FERTILIZERS BY THE AMERICAN INDIANS AND THE EARLY ENGLISH COLONISTS.[1]

BY G. BROWNE GOODE.

IN the course of a somewhat exhaustive study of the natural and economical history of that member of the herring family known on our Atlantic coast under such various names as "menhaden," "pogy," "bony-fish," "moss-bunker," "white-fish," "bay-alewife," "bug-fish," "yellow-tail" and "fat-back," *Brevoortia tyrannus* (Latrobe) Goode, my attention was incidentally called to a matter of some interest to anthropologists—the use of fish fertilizers in agriculture by the Indians of New England and Virginia. The menhaden is, at the present day, the source of an immense annual product of commercial fertilizers. In the year 1878 between 900,000,000 and 1,000,000,000, or perhaps 200,000 tons of these fish were captured between Cape Henry and the entrance to the Bay of Fundy. A large part of the catch is consumed by the numerous oil and guano factories of Maine, Rhode Island, New York, Connecticut and Virginia. After the oil has been extracted the remainder is dried and sold to farmers and to the manufacturers of super-phosphates and other artificial fertilizers, who use it as a "base for nitrogen." Agricultural chemists, in the rating of commercial manures, value the nitrogen contained in them at twenty-five cents a pound. The amount of nitrogen derived from menhaden in 1875 was estimated to be equivalent to that contained in 60,000,000 pounds of Peruvian guano, the gold value of which would not have been far from $1,920,000.

[1] Read before the Anthropological Society of Washington, November, 1879.

In studying the development of this great industry, my attention was naturally directed toward a search for the beginning of the employment of fish in agriculture. As I have narrated elsewhere at considerable length,[1] the present oil and guano industry originated in Maine, about the year 1850, through the experiments of an old woman, who, while boiling some fish for chicken feed, observed the accumulation of a scum of oil upon the surface of the water; and about this time, or a little later, small factories were established in Connecticut and Eastern Long Island. Long before this, however, the farmers of New England and New York were accustomed to manure their corn and potato fields with the entire fish, in a raw state. This custom prevails to a great extent, even to the present day, notwithstanding that the experience of thoughtful agriculturists has shown it to be injurious. The usual method in sowing corn is to place an entire menhaden in each hill, together with the few grains of seed, and in planting potatoes to lay down a continuous row of fish, head to tail, in the furrows, before the potatoes are put in. The oil thus introduced with the flesh into the earth is entirely useless as a fertilizer, and permeating the soil renders it peculiarly liable, first to become soggy and heavy, and then to bake hard and crack with the heat of the sun. Many farms in Connecticut and Long Island are pointed to as having been ruined by this mode of planting.

My friend Prof. Atwater has searched the annals of European agriculture, and can find no record of the use of fish fertilizers before 1850, since which time they have been employed to some extent in Norway, England, Prussia and France. In America, however, their use dates back to the first colonization, and doubtless, as I shall show below, among the Aborigines, long previous to the discovery of the country.

Important, and in fact unanswerable, evidence is supplied by the etymology of the two names, "menhaden" and "pogy" or "poghaden," in use in different parts of New England. I quote from a letter received from Mr. J. Hammond Trumbull, in 1874:

"In response to yours of the 14th (December), respecting the local names of *Brevoortia*, about all I can give you is in my note to the new edition of Roger Williams' Key, Ch. XIX. Williams names together, among spring fish, '*Aumsoûg* and *Munnawhat-*

[1] A History of the Menhaden, etc., in Report U. S. Commissioner of Fisheries, Part v (for 1877), 1879, pp. 1–529; pp. 161 *et seq.*

teaûg.' Under the former name are included several species of the herring tribe, *aum'su* (plural *naums'uog*) meaning 'small fish,' *Munnawhatteaûg* corrupted to *menhaden*, means literally 'fertilizer' (that which manures), this name was applied to the herring and alewife as well as the 'menhaden' proper—all these species being used by the Indians for manuring their cornfields.

"In the northern and eastern parts of New England, the *Brevoortia* is commonly called *pauhagen*, and probably in some localities 'poghaden' (as you write it and which is nearer the Indian original), though I have not heard it so pronounced by Eastern fishermen. This name in the Eastern dialects has precisely the same meaning as 'menhaden' (or rather *Munnawhatteaûg* in Southern New England). The Abnaki (*i. e.*, coast of Maine) name was *pookagan* as Rasles wrote it, and the verb from which it is derived he translated by '*on engraisse la terre.*'"

I next appeal to the records of the Colonies. In Governor Bradford's "History of Plimouth Plantation," is given an account of the early agricultural experiences of the Plymouth colonists. In April, 1621, at the close of the first long dreary winter, "they (as many as were able) began to plant their corne, in which service Squanto (an Indian) stood them in great stead, showing them both ye manner how to set it and after how to dress & tend it. Also he tould them, axcepte they got fish & set with it (in these old grounds) it would come to nothing; and he showed them yt in ye middle of Aprill, they should have store enough come up ye brooke by which they begane to build and taught them how to take it."[1]

Another allusion to the practice of the Indians in this respect may be found in George Mourt's "Relation or Journal of the Beginning and Proceedings of the English Plantation settled at Plimoth, in New England, by certain English Adventurers both Merchants and others. * * * London, 1622." "We set the last spring some twenty acres of Indian corn, and sowed some six acres of barley and pease, and, according to the manner of Indians, we manured our ground with herrings, or rather shads, which we have in great abundance and take with great ease at our doors. Our corn did prove well, and God be praised, we had a good increase of Indian corn, and our barley indifferent good."[2]

[1] Coll. Mass. Hist. Soc., 4th Series, III, 1856, p. 100.

[2] Coll. Mass. Hist. Soc., 2d Series, IX, 1832, p. 60.

The fish made use of by the early settlers of Massachusetts were doubtless in large part the spring alewife, *Pomolobus vernalis*, and perhaps also the summer alewife, *P. æstivalis*, and an occasional shad, *Alosa sapidissima*.

I can find no other direct allusions to the Indians in this connection, but may quote two passages relating to the practices of the early colony, which are quite significant in the light of those already presented. Thomas Morton, in his "New England Canaan," London, 1632, wrote of Virginia: "There is a fish (by some called shadds, by some, allizes) that at the spring of the yeare passe up the rivers to spawn in the pond, & are taken in such multitudes in every river that hath a pond at the end that the inhabitants doung their grounds with them. You may see in one township a hundred acres together, set with these fish, every acre taking 1000 of them, & an acre thus dressed will produce and yeald so much corn as 3 acres without fish; & (least any Virginea man would infere hereupon that the ground of New England was barren, because they use more fish in setting their corne, I desire them to be remembered, the cause is plaine in Virginea) they have it not to sett. But this practice is onely for the Indian maize (which must be set by hands), not for English grain: & this is, therefore a commodity there."

This passage is very interesting, describing as it does the use of fish fertilizers in Virginia two hundred and fifty years ago or more. To one who is acquainted with the habits of the herring family in the Virginia rivers and the persistency of local names, there can be little doubt that many menhaden were used as well as shad and the two kinds of river herring, all of these being common, in spring, in all the streams tributary to Chesapeake bay.

In Edward Johnson's "Wonder-Working Providence of Sion's Saviour in New England, being a Relation of the Firste Planting of New England in the yeare 1628," London, 1654, written in 1652, the author says: "But the Lord is pleased to provide for them (the colonists) great store of fish in the Spring-time, especially alwives, about the bignesse of a herring. Many thousand of these they used to put under their Indian corne, which they plant in hills five foot asunder; and assuredly when the Lord created these corne, Hee had a special eye to supply these His people's wants with it, for ordinarily five or six grains doth produce six hundred."

The following order from the records of the town of Ipswich, May 11, 1644, illustrates in a comical way the customs of the early colonists: "It is ordered that all the doggs for the space of three

weeks after the publishing hereof, shall have one legg tyed up, and if such a dog shall break loose and be found doing any harm the owner of the dogg shall pay damage. If a man refuse to tye up his dogg's legg, and hee bee found scraping up fish in a corne-field, the owner thereof shall pay twelve pence damage beside what ever damage the dogg doth. But if any fish their house lotts and receive damage by doggs, the owners of these house lotts shall bear the damage themselves."

From this time until the latter part of the last century, I can find no reference to the use of fish fertilizers, but there is no reason to doubt that the customs of old have been handed down by the local agriculturists from generation to generation.

I have been much astonished to find that the use of fertilizers by the uncivilized races of man has not been more frequently observed. Dr. Rau, with his extensive acquaintance of ethnological literature, tells me that he has met with but one allusion of the kind, that being in the writings of Garcilasso de Vega, who states that the Peruvians used bird guano for the purpose of manuring their plantations.[1]

Bancroft refers to one instance of the use of fertilizers by the

[1] "They used to dung their Lands, that they might make them fruitfull, and it is observable, that in all the Valley about *Cozco*, and in the hilly Countries, where they sowed *Mayz*, they esteemed the best manure to be Man's Dung; and to that end they saved and gathered it with great care, and drying it, they cast it upon their Land before they sowed their *Mayz*. But in the Country of *Collao*, which is above one hundred and fifty Leagues long, which, by reason of the coldness of the Climate, doth not produce *Mayz*, though it bear other sort of Grane, there they esteem the Dung of Cattle to be the best manure and improvement.

"By the Sea-coast, from below *Arequepa*, as far as *Tarapaca* which is above two hundred Leagues, they use no other Dung, but such as comes from the Sea-birds, of which there are great numbers and incredible flocks on the Coast of *Peru;* they breed in little Islands, which lie in the Sea, and are unpeopled, where they lay such heaps of Dung, that at a distance they seem to be Hills of Snow, in the times of the *Incas*, who were Kings, great care was taken of these Birds in the season of their Breeding; for then on pain of death no Man was to enter on those Islands, lest they should disturb the Birds, or spoil their Nests; nor was it lawfull to take or kill them at any time, either off or upon the Island.

* * * * * * * * * *

"Howsoever in other parts of that Coast, and in the Low Countries of *Atica*, *Aliquipa*, *Villacori*, *Malla* and Chilca, and other Vallies, they dung their grounds with the Heads of a small fish, like our Pilchards, and with no other soilage.

* * * * * * * * * *

"There are such quantities of Pilchards cast up by the Sea at those seasons, as are not onely sufficient for the Food of Man, and Birds, and for dunging the earth, but even to lade many Ships, if occasion should require. It is said that this Fish is chased ashore by some Dolphins, or greater Fish; be it by what means it will, the advantage is great, and the Providence of God is admirable in these His Blessings towards His poor Creatures."

Garcilasso de la Vega; The Royal Commentaries of Peru. Translated from the Spanish by Sir Paul Rycant, Lond. 1688, pp. 135–36.

Indians on the Pacific coasts. In describing the customs of the Maya tribes of Yucatan (Vol. ii, p. 717) he paraphrases a translation of the Quiché MS. by Brasseur De Bourbourg, in relation to the culture of maize by them: "And from the time of its traditional discovery by Gucumatz or Quetzalcoatl (the creator and former) down to the conquest by the Spaniards, and even down to the present time, the yellow and white maize, or their several varieties, have been the chief reliance of the Maya as of the Nahua nations for daily food. Every year, during the latter month of the dry season, from March to May, the farmer busied himself in preparing his *milpa* or cornfield, which he did by simply cutting or up-rooting the dense growth and burning it. The ashes thus produced were the only fertilizer ever employed, and even this was probably never needed in this land of tropical fertility. Just before the first rain fell, equipped with a sack of seed-maize on his shoulder and a sharpened stick in his hand, he made holes at regular intervals among the ashes, and in each deposited five or six grains, covering it with the same instrument, aided perhaps with his foot," etc., etc. This is evidently accidental rather than intentional fertilization, the main object of the burning being doubtless to clear away the obstructions to planting the seed. Dr. Rau also showed me accounts of the agriculture of various American tribes, and particularly a very full one of the culture of maize by the Iroquois, in Lafittau's "Mœurs des Sauvages Americains," Paris, 1724, none of which referred in any way to the use of manure.

While traveling on the north shore of Lake Superior last summer, Prof. Atwater learned that the Indians of that region employ, to some extent, white fish and lake trout in manuring their fields. Mr. W. H. Dall tells me that a rude system of agriculture is practiced by the Indians of Alaska, a system learned from the Russians since their occupation of the territory.

I have presented these few notes, not as a contribution to knowledge, but to call attention to a subject which seems to have been neglected in a most unaccountable manner. Can it be that the aborigines of the Northern Atlantic States are the only uncivilized people who have understood the use of agricultural fertilizers? Fish fertilizers naturally are inaccessible except to peoples living on large bodies of water abounding in schools of fish, which may be taken with ease in quantities greater than are

needed for use as food. Not less interesting, however, would be instances of the use of organic refuse derived from other sources. Can it be possible that the agricultural Indians of America, such, for instance, as the Moquis, have never thought of making this very obvious application of their domestic animals? When did the Aryan races take their first steps in provident agriculture? These questions must be extremely important to those who are studying the development of culture and civilization.

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A SKETCH OF COMPARATIVE EMBRYOLOGY.

BY CHARLES SEDGWICK MINOT.

IV.—THE EMBRYOLOGY OF SPONGES.

DURING the past six years our knowledge of the structure and development of sponges has made sudden and very great progress, perhaps greater than has occurred in any other department of zoölogy during the same period. The advance was introduced by the publication, in 1872, of Haeckel's monograph of the calcareous sponges. That work has been followed, in Germany, England, France and Russia, by numerous memoirs, among which the series of articles by Franz Eilhard Schulze stand first by their accuracy, their clearness, the beauty of the illustrations and the good temper (sometimes wanting in German scientific publications) of the criticisms on other investigators, but above all, by the value of the discoveries they announce. I think no zoölogist can read Schulze's papers without enjoying their rare combination of merits.

One of the results of these numerous recent researches has been to show that Haeckel's work is inaccurate to a startling extent. He figures in detail things he cannot have seen, because they do not exist, and he describes phenomena that do not occur. His fault is to make very positive statements and give very diagrammatic figures after a hasty examination, consequently his writings contain so numerous errors, sometimes about fundamental points, that even a positive statement of his, until confirmed by other investigators, has no authoritative value. This defect is most seriously to be deplored, for Haeckel is unquestionably one of the most daring and original thinkers of the modern speculative school, and many of his quickly made generalizations have

proved extremely fruitful, as others have been useless or misleading. Therefore, in spite of Haeckel's great and unusual endowments, which every one must recognize and admire, it is unsafe to quote his writings as authorities in matters of fact.[1] Having given my own opinion, I may add that while many of the younger naturalists bestow an almost unqualified admiration on Haeckel, several distinguished zoölogists severely condemn him as unscientific.

In order to understand the embryology of sponges, it is necessary to consider briefly their structure. The sponges of commerce are merely the skeletons of the living animals, the soft portions having been removed by maceration. During life the fibres, which make up the skeleton, are all covered by cells. The mass of the sponge is permeated by intercommunicating canals, connected with the exterior by numerous openings upon the surface, these openings are of two kinds, smaller ones called *pores*, by which currents of water enter the canals or tubes, and larger ones, or in some cases a single orifice, the *osculum*, through which the water passes out. The entire surface of the canals is lined by a continuous layer of cells, the *entoderm*. Over definite areas of this lining the cells are cylindrical, have a so-called collar, and are provided, each, with a single long sweeping cilium, or *flagellum (geissel)*, while over the intervening parts, the lining is composed of simple flat polygonal cells. In a few sponges *(Ascones)* the whole canal system is carpeted by flagellate cells. The flagella maintain the currents of water, sweeping in the particles of food, which are seized by the sponge as the water runs through. The external surface is entirely covered by a continuous stratum of flat polygonal cells, the ectoderm, between which and the canals lies the thick middle layer or mesoderm, in which the skeleton and the sexual products are developed.

The mesoderm is composed of numerous independent cells, each separated from its neighbors by amorphous intercellular substance, the specific character of which varies from species to species. Its consistency may be so slight that the cells can crawl about through it, like Amœbas. A certain portion of these cells are transformed into the genoblasts; usually either only eggs or only spermatozoa are produced in a single individual, but of those sponges, whose sexuality is known, a few are hermaphrodite.

[1] In Huxley's Anatomy of Invertebrates, the chapter on sponges is based on Haeckel's work and contains several important errors.

The various kinds of sponges are distinguished principally by their external shape, and the peculiarities of their skeleton and canal system. The form from which all sponges may be deduced is the Olynthus type, which has the following characteristics: 1, it is attached by its base; 2, there is a large vertical central cavity, which, 3, communicates with the exterior at the upper end, through the osculum, and 4, at the sides through the secondary canals and pores. Modifications, besides those before mentioned, occur in the relative size of the main cavity, and by the formation of additional oscula.

The principal kinds of sponges may be tabulated as follows:

A. Without any skeleton..........................Myxospongiæ.
B. With horny fibers (bathing sponges)...... ....Spongidæ.
C. With siliceous spicules (several distinct families)..siliceous sponges.
D. With calcareous skeleton....... ....Calcispongiæ.

The *Physemaria*, which Haeckel described as multicellular organisms, representing a permanent adult sponge-like gastrula condition, have excited the greatest interest among zoölogists. Recent investigations,[1] however, render it probable that Haeckel's description is entirely erroneous, and that these animals are really multinucleolate Rhizopods.

The *gemmulæ*, or winter buds, are not organs of sexual reproduction, but rather of regeneration. The tissues hibernate in a simplified condition, forming germ masses, the so-called buds; in the spring the sponge is regenerated by the renewal of its histological differentiation.

The formation of the egg presents no features requiring special comment from us. No polar globules have been discovered. Since the eggs and spermatozoa are ripe at the same time, the ova probably require to be fertilized, but I think no stage of the act of impregnation has yet been observed. The egg early becomes enclosed in a special capsule or follicle, developed by the neighboring cells of the mesoderm disposing themselves in a continuous layer around it. Within this follicle segmentation and the development of the embryo take place. It is a singularity of sponges, without a parallel among other animals, that the egg becomes the embryo without quitting its seat of formation—the follicle in which it grows up.

The sponge larva escapes from the body of the parent by

[1] E. Ray Lankester, Quart. Journ. Micros. Sci. 1879.

bursting the walls of the follicle, passing into the canal system, and escaping through one of the pores. At the time of its birth, the larval sponge has very distinctive peculiarities, and differs strikingly from all other larvæ.

The larva, when hatched, is egg-shaped (Fig. 16), the larger end is composed of large cells with granular contents, which hide the nuclei, while the pointed end consists of small cells, each of which bears a long vibratile hair, or flagellum. It is by these that the larva swims. During segmentation, however, the cells are all more or less alike, and the differentiation takes place in some species earlier, in others later, so that in some sponges *(Halisarca)*, there is even a stage in which the whole surface of the larva consists of small cells, and later, those cells around the large pole of the egg grow bigger and granular. Again, in some forms (e. g. *Chalinula)* the difference between the two sets of cells is much less, and the small cells cover a proportionately much larger area than in the embryo figured (Fig. 16).

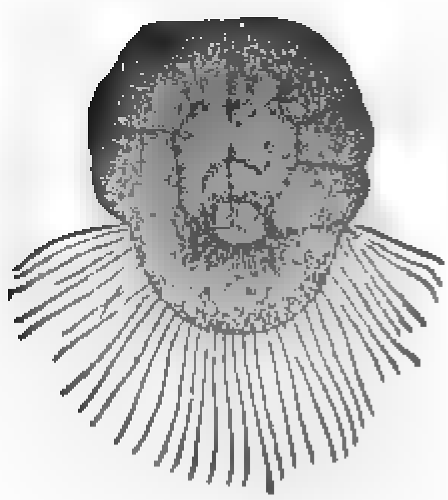

FIG. 16—Egg-shaped larva, youngest free-swimming stage. *Sycandra raphanus*, after F. E. Schulze. About 530 diam.

There are also cells in the interior of the embryo, leaving, however, in certain cases a central cavity. Schulze states that in *Sycandra* there are no central cells, but Metschnikoff describes and figures them. These central cells are regarded by several authors as the primitive mesoderm.

The metamorphosis of the larva into the sponge has been observed in but very few species. The change takes place according to two distinct types, which cannot at present be brought into relation with one another, because in the first *(Sycandra)*, the large cells form the ectoderm, and the small cells the entoderm, while in the second *(Chalinula* and *Halisarca)*, the destiny of the two sets is exactly reversed, the small ciliated cells remaining external, the large cells becoming internal. In the latter case the embryo attaches itself by its broad end to a solid body, the small cells grow over the whole of the exposed surface; a branching cavity is formed in the interior, and pores and an osculum break through. There cannot be said to be any gastrula stage at all, nor does the osculum answer to an opening formed

by invagination. The skeleton begins to appear about the time the larva fixes itself.

In the other type of development, which has been observed in the higher calcareous sponges, there is both a temporary *pseudo-gastrula*, and a permanent gastrula differently formed, which is directly metamorphosed into the permanent sponge. The pseudo-gastrula normally occurs only before the larva leaves the follicle of the parent body, and arises by the turning in of the large cells, just as the finger of a glove may be inverted; the larva then appears like a cup formed of two membranes, the outer of small cells, the inner of large. Before long, however, the large cells are everted, and the embryo (Fig. 16) reassumes the characteristic egg-shape, and soon leaves the parent, swims about freely for two or three days, and finally permanently attaches itself.

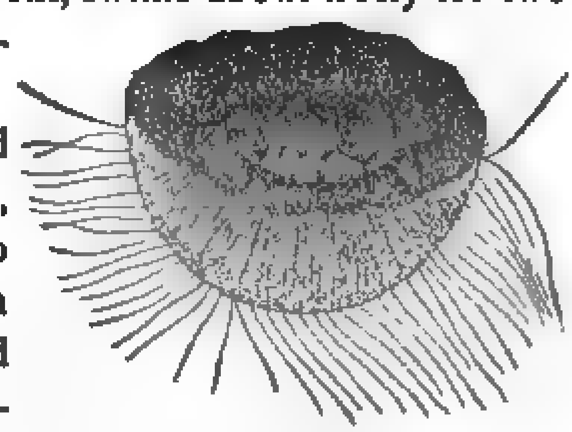

Fig. 17.—Older stage of Fig. 16.

While still free, it broadens, and its long axis shortens (Fig. 17), whereby the large cells begin to grow over the small ones, which are gradually pushed in more and more until they are fairly invaginated. The large cells advance further, gradually constricting the opening until it becomes quite small. Viewed from the oral side, at this stage, the embryo presents the appearance indicated by the outline, Fig. 18, *A*.[1] At this stage the larva fixes itself by its oral end. The cells around

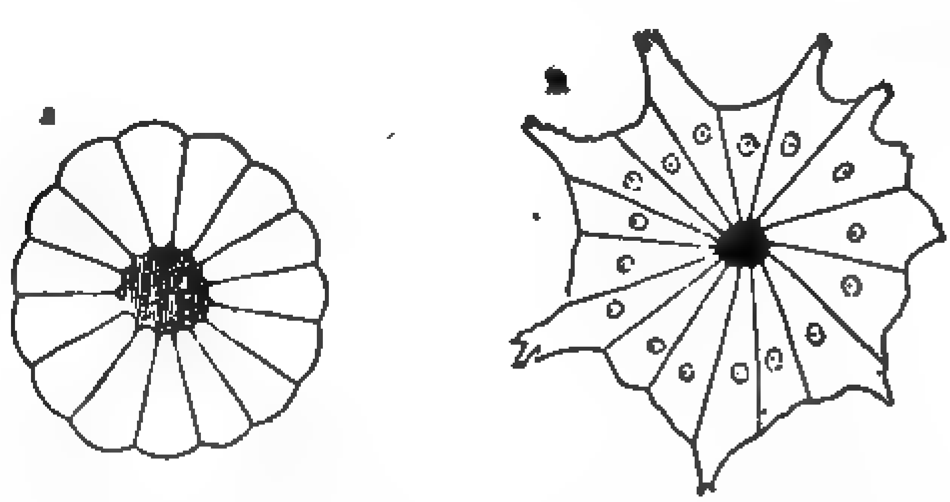

Fig. 18.—*A*. Oldest free-swimming stage, view of oral surface. *B*. The same after attachment. Larva of Sycandra, after F. E. Schulze, magnified about 240 diam.

the mouth nestle against the underlying surface, and send out

[1] In nature the upper and inner parts show through, rendering the outlines much less distinct.

from their external edges hyaline amœboid processes, which probably help the larva to hold on (Fig 18, *B*). The central ends of the cells approach one another, meet and close the mouth. Fig. 19 presents a side view of a larva in this stage, and shows the inner cavity *c*, now closed; its lining of small cells *b*, and the exterior layer of granular cells *a*, the arrangement of which is particularly obscure, but they ultimately make the ectoderm and mesoderm.

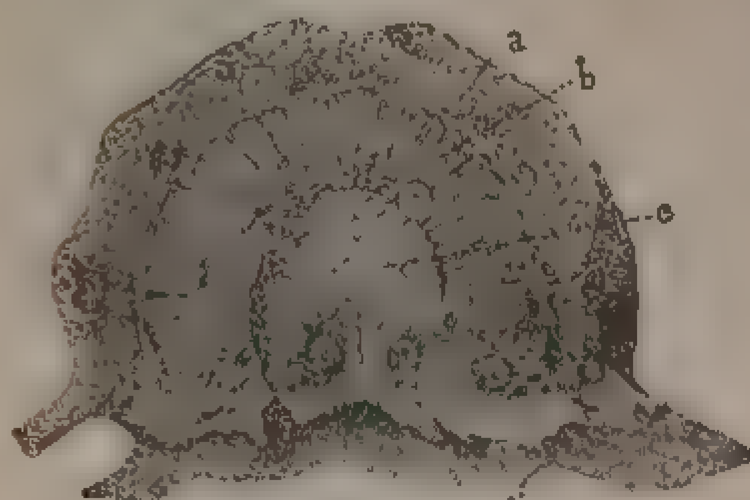

FIG. 19.—Vertical optical section of the attached larva of *Sycandra raphanus*. After F E Schulze, magnified about 500 diam.

The development now proceeds by the vertical elongation of the sponge to a cylindrical shape; the formation of a large secondary opening, the osculum at the upper end, and of small openings, *pores*, around the sides, leading into secondary tubes, which communicate with the large central cavity; finally the development of the skeletal spicules and of the mesodermic intercellular substance. The first spicules that appear are simple rods tapering towards both ends, and slightly curved. They lie nearly parallel to the external surface, scattered irregularly. Three and four rayed spicules also soon appear, and the whole skeleton grows rapidly. The sponge is now in the Olynthus stage.

The above account, though necessarily brief, shows that our present knowledge does not render the morphology of sponges explicable, because, although we should certainly consider, if we knew the larvæ alone, the small flagellate cells to be strictly homologous in all the embryos, yet in one case these cells form the internal digestive cavity, in another the external skin. At present the meaning of this divergence is unknown.

The systematic position of the sponges has been much discussed At one time they were considered protozoic colonies, which they certainly are not. German zoologists usually connect them with the Cœlenterata, but inasmuch as the development is not in the least cœlenterate, and the structure of the adult sponge

is in nearly every respect peculiar, it seems to me best to accept Prof. Hyatt's view, and place sponges by themselves as a distinct sub-kingdom of animals, the *Porifera.*

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I. Sycandra, XXV, p. 247. (Suppl. band) Cf. XXVII, 486.
II. Halisarca, XXVIII, p. 1.
III. Chondrosiden, XXIX, p. 87.
IV. Aphysinidæ, XXX, p. 379.
V. Die metamorphose von Sycandra raphanus, XXXI, p. 262.
VI. Spongelia, XXXII. p. 117.
VII. Spongidæ, XXXII, p. 593.
VIII. Hircinia and Oligoceras, n. g., XXXIII, p. 1.

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LIST OF THE BIRDS OF THE WILLAMETTE VALLEY, OREGON.

BY O. B. JOHNSON.

THIS is not meant to be a complete list of the avifauna of the region named, but only such a part as has fallen under my personal observation during a residence of over ten years at three different points, viz: Five years at East Portland, which is but six miles from the Columbia river; two years at Forest Grove, twenty-five miles west of Portland and at the foot of the Coast

mountains; and the rest of the time at Salem, on the Willamette river, and fifty miles south of Portland. The region referred to lies between the Cascade and Coast ranges, on an average of sixty miles apart, and from the Columbia on the north to the Callipoaia mountains on the south, a distance of about one hundred and thirty miles. To the north, and along each side, and on the streams, it is densely wooded, while on the middie and south is a chain of prairies of greater or less extent, giving great variety to the landscape. I have been necessarily brief, but with any one needing more explicit notes or material, I will gladly correspond.

1. *Turdus migratorius* Linn. (robin).—The robin is very common during the breeding season, nesting extensively, and not rare during the mild wet winter months, especially along the river bottoms.

2. *Turdus nævius* Gmel. (varied thrush), called "Cal. robin," "myrtle robin," "painted robin," and "Oregon robin."—More or less abundant during the winter months, arriving from the north and mountains about December 1st, and remaining until about June 1st. Usually shy and very thrush-like, they sometimes become quite tame about building, learning the habit from the common robin. I have always suspected that they nest in this State, about the bases of the snow-clad mountains, as hunters have told me that they have seen the bird at all times during the season in those places. They have no true song, but in its place they use the call note, which is a prolonged "*chur-r-r*," followed after a short interval by a prolonged "*chee-e-e*" a "third" higher, and both in a minor key. The alarm note is a short decisive "*churk*." They feed upon the ground, scratching among dead leaves, usually in very moist situations. They also come to the gardens for cherries and small fruits.

3. *Turdus ustulatus* Nutt. (Oregon thrush). — Very common during the breeding season, nesting extensively and often raising two broods. The usual situation of the nest is in a dense thicket of low brush about four feet from the ground; it is composed of moss, very bulky and rather more attractive than otherwise, but I found one at the root of a maple tree upon a "burl" about four inches above the ground, two others were in a tree, about fifteen feet high, and composed entirely of twigs and brush well woven, and scantily lined with moss. The alarm note is a short whistle "*whoet*," identical with that of a person attracting the attention

of a dog, the call note is tremulous, "*whaat-r-r-r*," in the same key as the alarm note, only ending in a trill. Every evening and often on cloudy days, their song can be heard from every thicket; it is a peculiar whistle, ascending a scale of four notes, and sounds like "*holsey-govendy-govindy-goveendy*." They feed upon the ground.

4. *Sialia mexicana* Swains. (Western bluebird). — A common summer resident, breeding in deserted woodpecker's holes, knot-holes and crevices, especially delighting in favorable situations about buildings; they will for years return to the same place, even if roughly treated. Their only note is a mournful "*soenk*." They feed upon the ground, dropping upon their prey from an elevated position.

5. *Cinclus mexicanus* Swains. (water ouzel).—Found on all the dashing streams in the valley. I saw but one nest and that was shown me by the owner of a mill, and he said that a brood had been raised for four successive years in the same nest. It was placed between the ends of two projecting planks in the dam, and was an open nest, the upper plank rendering the dome part superfluous; it was of moss and the bark of the cedar from the logs in the vicinity. I suppose that they remain all winter, for I saw them in the Bitter Root mountains, in Idaho, when ice was forming on the streams and the snow two feet deep. The alarm note is a faint "*chip*," expressing interrogation rather than fear, and a song that is seldom heard, owing to the rushing and roaring surroundings; it comes as a faint lisping "*sweet-tweet tr-r-r-eet*," very prolonged, but rendered almost inaudible by its turbulent accompaniment. Their food, I suppose, is entirely aquatic, though I had one make an unsuccessful attempt at an artificial fly cast near it, showing that it knew a "tit-bit" as well as its scaly neighbor.

6. *Regulus satrapa* Licht. (golden-crowned kinglet).—Common throughout the winter in flocks, busily searching for insects among the dense second growth of *Abies douglassii*. Their note at this time is a very faint "*tseep*," answered quickly by the others. I have never seen the eggs or nest.

7. *Regulus calendula* Licht. (ruby-crowned kinglet).—Solitary individuals seen occasionally during the winter and spring among the thickets of rose and Spiræa. Never saw its nest or eggs.

8. *Parus occidentalis* Baird (western titmouse), called "chickadee."—Common throughout the year; breeding abundantly in

holes which they excavate in rotten wood, often in stumps not more than two feet from the ground ; nest of hair and wool ; eggs five, pure white, thickly speckled with light-brown, chiefly toward the large end. Its note is a loud, clear "*chick a dee-dee-dee,*" given in a monotone.

9. *Parus rufescens* Towns. (chestnut-backed titmouse).—Less abundant than the last, which they closely resemble in habits. A nest that I found in the top of a willow "stub" (not excavated) contained four pure white eggs, somewhat larger than the preceding species, dotted sparingly with large patches of fawn-drab. The nest was lined with fur of a squirrel. Their note is a faint "*ke-dee-dee-dee,*" the last syllable uttered a "fifth" higher.

10. *Psaltriparus minimus* Towns. (least titmouse).—Plentiful during the winter months among the evergreens, always in small flocks. Many remain all summer to breed, but they are more retired and less conspicuous. I took a nest of this species in June, 1874; it was pensile, built of moss (Hypnum and Tillandsia), with the entrance (a small round hole) on one side, passing up and over into the inside; it was lined with feathers and hair, and contained four pure white eggs. Their call note is a subdued "*zip,*" "*zip,*" varied to "*zip-kitty.*".

11. *Sitta aculeata* Cass. (Western nuthatch).—Quite common during the summer and not rare during the winter. They breed in various places, the greatest desire being concealment. A pair had a nest in the college building at Forest Grove and raised seven young; the entrance was a knot-hole in the siding, and it was placed between the ceiling of the lower room and the floor above and was not accessible. Another was built for several years in the double roof of an ice-house upon the sawdust. I took out a set of nine eggs in 1877, white, specked with light brown of the same shade and pattern as *Parus occidentalis*, differing only in larger size. Their only note is a coarse harsh "*swank,*" uttered at intervals that make one expect to see a larger bird.

12. *Sitta canadensis* Linn. (red-bellied nuthatch).—Associated with the preceding, which it much resembles in habits. Its call, "*beek,*" is in a higher key and not so coarse. The nest and eggs I have not seen.

13. *Thryothurus spilurus* Vig. (Western mocking wren).—This bird is quite common in the swampy parts of the valley, and breeds, though I never saw its nest or eggs.

14. *Troglodytes parkmani* Aud. (Parkman's house wren).—Common during the summer and breeds plentifully, any place being "just right." I saw a nest in the pocket of a pair of trousers used as a "scare crow." In retaliation for their driving away a pair of blue-birds from a box at my house, I began taking the eggs, and succeeded in getting twenty-one, when I grew ashamed, and they afterwards laid and hatched five more. The song is like that of the Eastern species.

15. *Troglodytes hyemalis* Vieill. (winter wren).—Remains during the winter, living in semi-clearings under brush and log heaps, but leaves for other parts to breed.

16. *Anthus ludovicianus* Gmel. (titlark).—Common during winter, feeding in old fields and in roads.

17. *Helminthophaga celata* Say (orange-crowned warbler).—Very common during summer, and undoubtedly breeds, but I have never found its nest.

18. *Dendrœca æstiva* Gmel. (summer warbler).—A very common summer resident, nesting extensively, with the usual habits of the species.

19. *Dendrœca auduboni* Towns. (Audubon's warbler).—The most abundant warbler during summer, and a few remaining until far into, if not all, winter. It probably breeds commonly, but I have been able to find but one nest, taken May 26, 1879. It was placed in the top of a small oak *(Q. garryana)*, about fifteen feet from the ground, and placed between three upright twigs, built of grass and horsehair, and lined with feathers from a neighboring fowl-yard; it contained four greenish-white eggs, spotted around the larger end in a ring with light-brown and lavender, and a few dots of brownish black; they measured .72 by .54, .71 by .54, .70 by .52 and .70 by .52 of an inch.

20. *Dendrœca coronata* Linn. (yellow-crowned warbler).—I have obtained several birds in spring that I have referred to this species.

21. *Dendrœca nigrescens* Towns. (black-throated gray warbler. Moderately common during summer in favorable situations, seeming to prefer dense undergrowth near a swamp. I took a nest of this species June 17, 1879, in the top of a clump of Spiræa, built of fine roots and dried grass and lined with the down of the cottonwood It contained four eggs of a dirty-white color, thickly marbled with longitudinal lines and dots, more confluent

toward the larger end, of two shades of light-brown. They measured .66 by .53, .65 by .54, .65 by .54 and 65 by .52 of an inch.

22. *Geothlypis trichas* Linn. (Maryland yellow-throat).—A very common little resident during summer among the reeds and thickets about marshes, where they breed.

23. *Geothlypis macgillivrayi* Aud. (Macgillivray's warbler).—A summer resident, nesting quite commonly; it is usually placed in the very top of a rose thicket and hardly concealed; it is built of dried grass and leaves, and very loosely woven. Eggs usually four, pure white, sprinkled around the larger end with splashes and irregular dots of lilac, pale-brown and umber.

24. *Icteria longicauda* Lawr. (long-tailed chat).—Inhabits the dense thickets of Spiræa during the summer, and probably breeds, though I have not seen its nest.

25. *Myiodioctes pusillus* Wils. (green black-capped warbler).—Only noticed during the spring migrations.

26. *Hirundo lunifrons* Say (cliff swallow).—Abundant during summer, breeding chiefly under eaves.

27. *Hirundo bicolor* Vieill. (white-bellied swallow).—Also abundant, nesting in holes in trees.

28. *Hirundo thalassina* Swains. (violet-green swallow).—Also abundant, nesting in knot-holes and crevices about buildings; have never seen their nest in any other situation; among peculiar places, I saw one in a hollow east window sill, another under the tin top of a wooden capital, twelve feet above the sidewalk, another was under a sign that lay flatwise on the awning, another in an old hat that hung in a shed. They are decidedly the most familiar of the three species of swallows.

29. *Vireosylvia solitaria* Vieill. (blue-headed flycatcher).—A common summer resident, chiefly among deciduous trees, where it also nests. The nest is subpensile in a low horizontal fork, neatly and compactly built of fine grass and horsehair, lined with fine moss and spiders' webs, and externally covered with bits of Hepatica and Hypnum to resemble a piece of bark. The eggs, usually four, pinkish-white, covered at the large end with reddish-brown dots and marks. The song is irregular, "*to whit-to whee—to whit-to wheo,*" repeated incessantly as they flit among the leaves for food, their favorite tree being the large oak (*Q. garryana*).

30. *Ampelis garrulus* Linn. (waxwing).—I obtained a pair of

these beautiful birds during a snowstorm in January, 1876, at Forest Grove. They were feeding at the time on rose berries.

31. *Ampelis cedrorum* Vieill. (cedar bird).—An abundant summer resident, nesting extensively in the groves of small Douglass spruce.

32. *Collurio borealis* Vieill. (Northern shrike).—Quite common resident, though I have not found it breeding.

33. *Pyranga ludoviciana* Wils. (Louisiana tanager).—Another one of those common summer residents that seem to defy all attempts at the discovery of its nest.

34. *Curvirostra americana* Wils. (red crossbill). Common among the evergreen covered mountains, and coming down to the valley in winter. I have not seen its nest.

35. *Carpodacus californicus* Baird (Western purple finch).—Common summer resident, and breeds, though I have not yet found a nest. It is noted for its habit of cutting off the bloom of the cherries for the embryonic seed therein. Its note of alarm is a "*quit—quit,*" and its song a warbling "*whidly-whidly-whidly,*" repeated very rapidly.

36. *Chrysomitris tristis* Linn. (yellow bird). A common summer resident, breeding extensively, with the usual habits of the species.

37. *Chrysomitris pinus* Wils. (pine finch).—A common winter resident, living in flocks, and frequenting fields and gardens for seeds, virtually taking the place of the preceding at that time. It probably breeds in the mountains.

38. *Hesperiphona vespertina* Coop. (evening grosbeak).—Sometimes plentiful during the spring migrations, frequenting the maple *(A. macrophyllum)*, the seeds of which are a favorite food. The only note I observed was a loud "*yeeip,*" strikingly like the call of a lost chicken.

39. *Passerculus sandwichensis* Gmel. (Alaskan sparrow).—Seen sparingly during the migration, which is usually in small flocks.

[*To be continued.*]

A BOTANIST IN SOUTHERN CALIFORNIA.

BY JOSEPH F. JAMES.

HE who would see California at her best, should come here in the spring. If the traveler arrives about the middle of March, he will find the spring in all its beauty and freshness. After his passage over the snowy Sierra, he will be delighted at the change from ice and snow to green grass and flowers; from cold and cutting northern winds to gentle balmy southern breezes. The sky will appear of a brighter blue, and the grass of a greener tinge than he ever saw before, and he will feel a vigor and a freshness which he has not felt in many a long day. There seems to be a something in the air of California which makes it different from what it is elsewhere. It may be that it is possessed of more ozone than common, and the presence of that material freshens up one's thoughts and feelings. The rains of the winter season will then be over, and the grass and flowers will be seen in all their verdure and freshness. On the other hand, should he arrive in the summer, he will find everything dried and parched; and as first impressions are always the most lasting, it is likely that he will have a much poorer opinion of the country than if he had seen it first in all its beauty.

To a botanist, California is almost a paradise, and although he will not find in it much of that magnificent vegetation, and those grand and interminable forests which are characteristic of the tropics, we venture to say that he will find here as many, or nearly as many, curious and interesting forms of vegetable life as he can find in any other country of the world. The distribution of rain during the year has been the cause, at least in Southern California, of a peculiarity in the development of vegetable life. Rain falls only from November to March, and the remainder of the year is dry and hot. By the middle of June or July many of the plants and flowers have disappeared; the grass is dry and parched, and the whole country assumes an appearance which is extremely depressing. Most all the flowering plants appear, therefore, in the spring, and it is almost next to useless to hunt for them, except along the banks of streams and in deep shaded cañons, after the first of June.

But the spring! Ah! that is the time. It would be almost impossible to find a more beautiful sight than is then visible in

the vicinity of Los Angeles, the metropolis of Southern California. Then the plains surrounding that city, the hills and the valleys are one mass of gorgeous brilliant flowers. They are there by thousands upon thousands, and of almost endless variety. We shall attempt to enumerate some of them, and give a general idea of the appearance of the country in its season of beauty.

Most conspicuous of all, both for its abundance and its color, is the California poppy (*Eschscholtzia californica* Cham.). Never have I seen such a brilliant mass of color as was presented by this plant last spring. It covered acres of ground, and the bright golden yellow or orange of its flowers, conspicuous among the mass of other verdure, was visible for miles. I have one patch in my mind now which, seen on a bright clear day, was, with the sun shining full upon it, too dazzling for the eye to gaze upon. Truly it was the " Field of the Cloth of Gold." In places where the ground had been plowed, paths of it had been left, and they seemed like tongues of fire running over the ground.

Two species of Alfillerilla, or pin clover (*Erodium cicutarium* L'Heer and *E. moschatum* L'Heer), are very common. These are very valuable as forage plants, and without them it is hard to tell what the country would do. Both species are very similar, one having the leaves more finely dissected than the other. The flowers are small and of a bright purple. The seeds are peculiar. After the petals have fallen the pedicels become deflexed, but the seeds still stand upright. They are five in number, united to a stylus, and each one is furnished with an awn an inch or so in length, with hairs at the base. When the seeds ripen and dry, they split the capsule at the base, and each one begins to twist on its own account; when they get through, the awns of all are closely twisted together, and the seeds stick out on all sides. If one seed is separated from the others before it is fully ripe, and examined, the awn will be seen to twist. It drys very rapidly, and in the contraction turns the seed round and round till a close coil about half its length is formed, and this coil sticks out at right angles from the seed. On wetting the awns again, they will untwist and become as straight as before. This seems to me to be a provision of nature for forcing the seed into the ground. Be that as it may, the seed itself is very hard and sharp pointed, and has a faculty of sticking very close to anything it gets into.

The *Sidalcea malvæflora* Gray, is one of the prettiest and com-

monest of the plants of the plains. It grows from one to two feet high, and has the large purple flowers interruptedly ranged on the stem, with the round cordate and crenate leaves at the base. *Platystemon californicus* Benth., known as cream cups, is very common. The flowers are white or cream colored, and are raised on naked hairy peduncles four to six inches long, looking something like an Anemone. *Dodecatheon meadia* L. (var ?), the shooting star, common in the East, is occasionally seen, and with its pretty and curiously shaped flowers reminds one of the rocky banks and shady ravines where it finds its Eastern home. Several species of Orthocarpus, with small curious purple flowers, are common; one species (*O. purpurascens* Benth.) is small and inconspicuous in itself, but it grows in dense masses, covering the ground for miles, and giving it a purplish hue. The *Bæria gracilis* Gray, a small composite plant with bright yellow flowers, is so common as to cover acres of ground and add its quota to the general glory. *Sayia platyglossa* Gray, is also common; its yellow flowers tipped with cream color. Occasionally a patch of *Pæonia brownii* Dougl., greets the eye with its large dark purple or reddish flowers, and heavy thick bright-green leaves. The poor man's weather glass, or pimpernell (*Anagallis arvensis* L.), with its bright pinkish flowers, is common in cultivated grounds. *Collinsia bicolor* Benth. with bright purple flowers, hides itself modestly under greasewood bushes and sage brush. *Castilleia passiflora* Bong., with its flaming scarlet flowers, looks, in the distance, like the *Lobelia cardinalis*, that beauty of the swamps and meadows of the East. *Penstemon cordifolius* Benth., and *P. centranthifolius* Benth., adorn the banks of streams with their scarlet flowers. In shady places the tall green *Scrophularia californica* Cham., similar to *S. nodosa* L., towers far above the low but pretty *Claytonia perfoliata* Donn., with its raceme of white flowers. This last delights in damp shady places, and in such localities it is very common. *Salvia carduacea* Benth., is common in dry sandy soil, as is also *S. columbariæ* Benth., with its cluster of blue flowers. The *Amsinckia spectabilis* Fisch and Meyer, a small inconspicuous plant with yellow flowers, is so common as to cover acres of ground. Two species of Phacelia (*P. ramossisima* Dougl. and *P. tanacetifolia* Benth.), with white and blue flowers, are common, while their near relative, *Nemophila aurita* Lindl., with pretty blue flowers, and weak in the stem, helps to raise

itself above the ground by climbing with its prickly stem up other plants. *N. insignis* Dougl., also with blue flowers, is very pretty and common, and is one of the earliest spring flowers.

The species of Gilia are very numerous, and many of them have such differently shaped flowers, and such varied habits of growth that a novice would never place them in the same genus. There is the *G. californica* Benth., which has large funnel-shaped purple flowers, and leaves awl-shaped and bristle-like, and grows into quite large bushes. As an opposite is the *G. intertexta* Steud., a dwarf form of which has small white flowers, and forms a mat spread out close on the ground. Then the *G. multicaulis* Benth., with its short upright stem, and small bunch of purplish flowers is very different from the *G. densifolia* Benth., with a white wooly stem, linear pointed leaves and large bright blue flowers in dense clusters.

The *Convolvulus occidentalis* Gray, with its large white flowers, twines over the ground and bushes. Though the Liliaceæ are not numerous in species, there is one, *Calochorus splendens*, which is very handsome. The flower is quite large, of a purple-blue color, raised on a long slender stem, and as it waves to and fro in the air, it well merits its name of "splendens." *Datura meteloides* D.C., common on the roadsides, quite puts to shame its relative the "Jamestown" weed, of the East. It has large white flowers, six and eight inches long, and forms a bush two or three feet high. It possesses none of that vile odor peculiar to the "Jamestown," but has rather an agreeable smell. *Mirabilis californica*, one of the Nyctaginaceæ, is common all over the hills, and has viscid, sticky leaves and stem, and bright purple salver-shaped flowers. *Euphorbia albomarginata* forms large mats on the ground, one plant sometimes covering very closely a space two feet in diameter. *Sisyrinchium bellum* takes the place of the Eastern *S. bermudiana*, which it very much resembles.

One of the handsomest plants I have ever seen anywhere, is the *Yucca whipplei* Torr., commonly known as the Spanish bayonet, and it is quite common around Los Angeles. Never shall I forget the sensation I felt the first time I saw this beautiful plant. We were riding up a cañon, near San Juan Capistrano, toward the warm sulphur springs, when off to our right appeared a tall mass of white. What it was we could not tell, but riding toward it, we soon had it revealed to us in all its beauty and

majesty. Imagine a stalk ten or fifteen feet in height, two inches in diameter at the base, branched like a candelabra and covered for six or eight feet of its height with a mass of cream-colored, bell-shaped, drooping flowers. At the base the long, sharp, serrated leaves stuck out on all sides, as if to guard against the approach of any injurious animal. When seen standing along the mountain side, its white mass of blossoms outlined against the dark background of the naked rock, it looks like a sentinel keeping guard over the valley; and numbers of them ranged one after another, and one above another, looked like a troop of soldiers placed there to stand guard. They grow in such steep and inaccessible places oftentimes that it is impossible to get at them. As it gets old the leaves become frayed at the edges, and the fibers hang like long filaments down each side of the leaf.

Ranunculus californicus Benth., is very common in wet and damp places, and *R. cymbalaria* Pursh., grows in great profusion in the sand on the bank of the Los Angeles river. *Viola pedunculata* Torr. and Gray, with its pretty yellow and black flowers, is conspicuous amid the flowers of the plains, and *Nasturtium officinale* R. Br., almost blocks up the water of slow-flowing and shallow streams. It grows in shady places, sometimes three feet high, and in such dense masses as to make it difficult to force one's way through it. *Vitis californica* Benth., the only representative of the Vitaceæ in California in a wild state, is common, and climbs high over the willow hedges and bushes in damp localities. The deadly *Rhus diversiloba* Torr. and Gray, own cousin to *Rhus toxicodendron* L. of the East, is too common all over the plains, hills and cañons of Southern California, and while some persons can handle it with impunity, others barely touching it are afflicted with a severe cutaneous eruption. *Tellina cymbalaria* Gray, is a very pretty little plant with radical leaves and a cluster of white flowers on the end of a long scape. It grows in damp shady places, and is very common.

There are several genera which are very common all over California, and many of the species resemble each other so closely as to be nearly undistinguishable. Among the Leguminosæ, for instance, the genera Lupinus, Hosackia and Astragalus are all large. The species of the last are very numerous, and so closely connected as to cause great trouble in separating them. Nearly all the species have white or yellow flowers, pinnate leaves and

bladdery pods. The rattle weed is one of them, and is so named because the dry pods swept over the ground by the wind make a noise like the rattlesnake's warning. Another is the Loco plant, a terror to owners of horses and cattle. It is said that when eaten by animals it acts like a slow poison. A horse, for instance, seems to be affected in the brain; he becomes stupid, easily frightened at any little object coming suddenly before him, is inclined to run away, and often goes mad, insane, and to wind up all, dies from its effects. A locoed horse can easily be detected by the dull stupid look in his eyes. Among the lupines there are some of our most gorgeous flowers. The shrubby species often grow four and five feet in height. The *L. rivularis* Dougl., has large bright green leaves and spikes of bright blue flowers, often two feet in length. As an antithesis to this there is the *L. micranthus* Dougl., which is from four to eight inches high and has small white or blueish flowers. The *Hosackias* are sometimes bushes four to six feet high, and sometimes lie flat on the ground, the stems of a single plant being three to five feet long. The flowers are generally yellow, and the leaves small and three-parted.

Along all the roads, and covering the ground otherwise devoid of vegetation, we see the mock orange (*Cucurbita perennis* Gray); the flowers are quite large and yellow, leaves very rough and scabrous, and the fruit hard, round and yellow, looking like an orange. The root extends into the ground three or four feet and is sometimes as big round as a man's body. The *Megarrhiza californica* Torr., another species of the Cucurbitaceæ, twines over the rocks and bushes in a luxuriant manner; it has long tendrils which are slightly sensitive; when rubbed on one side, they soon bend toward that side and twine round any support they may happen to touch. Along in July the *Clematis ligusticifolia* Nutt., with its panicles of white flowers or carpels with long silky tails, climbs over shrubs and into trees along the water courses. *Brassica nigra* Boiss, the common mustard, is one of the most pernicious weeds of the whole of Southern California, and it covers the ground in many places for acres, to the entire exclusion of other plants. Sometimes it is eight and ten feet in height and two or three inches in diameter at the base. I have ridden through fields of it early in the spring when it was as high as the saddle on the horse. *Malva borealis* Wallman, is another very troublesome weed, and grows everywhere round houses and

in waste ground; in old sheep and cattle corrals it is especially luxuriant, and grows sometimes so thick and strong that even a horse has difficulty in forcing his way through it. It closely resembles *M. rotundifolia* L.

Several genera of Onagraceæ are abundant in species and specimens, Œnothœra and Godetia being the most abundant. A small plant belonging to this order, *Clarkia elegans* Dougl., is found in shady cañons, and is remarkable for its queer-shaped, handsome, purple flowers, and is often cultivated. The *Zauschneria californica* Presl., has bright red flowers, and adorns dry banks and hills in the summer. *Isomeris arborea* Nutt., one of the Capparidaceæ, is a small shrub with yellow flowers and inflated pods, and is very common near San Diego, flowering in November. A species of Hydrocotyle is very common in slow-flowing streams, and its circular crenated leaves seem to float on the water, and amongst them are thousands of specimens of *Azolla americana*, covering the surface of the water with its green mantle for considerable spaces.

I have confined my attention in this article almost entirely to the herbs and shrubs, and have by no means exhausted the list of them. Species are very numerous in Southern California, and I may, another time, have something to say in regard to the trees and larger vegetation generally of the country.

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PROGRESS OF AMERICAN CARCINOLOGY IN 1879.

BY J. S. KINGSLEY.

AMERICAN science, when compared with that of Europe, does not present a very creditable appearance. In the physical sciences almost every country of the old world is far ahead of the United States. With geology it is about the same, while in biology, American work, with a few conspicuous exceptions, has not surpassed a low state of mediocrity. The pages of the numerous scientific journals are filled with descriptions of new species, faunal lists and even worse nonsense, while anatomical and embryological papers are few and far between, and even then the majority of them are fragmentary and abound in errors of observation. In the philosophy of biology, America has done almost nothing. It is not the place in an article of this series, to insti-

tute an inquiry as to the reasons for this low condition of science. There is an institution in this country known as "The American Association for the Advancement of Science," surely a high sounding title; but would it not be well for the Association to begin to carry out its object? to do something for the advancement of science? Judging from the character of the papers published in its somewhat voluminous proceedings, it acts as a drag rather than an aid to progress. I might here add that aside from its grants of money to the Zoölogical and Geological Records, and to specialists to enable them to carry out certain lines of investigation, its British prototype is no more worthy of its pretentious name.

The American carcinological literature of 1879, may be considered under three heads, systematic, anatomical and developmental. Systematic papers have been published during the past year by Dr. Walter Faxon, Messrs. Oscar Harger, C. L. Herrick and J. S. Kingsley, Prof. A. S. Packard, Jr., Mr. John A. Ryder and Prof. S. I. Smith. Mr. Faxon gives an account of a species of *Lucifer*,[1] provisionally referred to the species *typus* of Milne Edwards. Mr. Ryder describes as new *Chirocephalus holmanii*[2] and *Streptocephalus sealii*,[3] from New Jersey. Having seen specimens of the former species, I can say that it is not a species of *Streptocephalus*, as Dr. Packard seems to suspect,[4] but truly belongs to the genus *Chirocephalus*, where Mr. Ryder placed it. Dr. Packard has recently[5] proposed a new order, *Phyllocarida*, to receive *Nebalia* and its fossil allies; and in his recently issued Zoölogy[6] has given a new classification of the Crustacea, which was repeated in outline in the December NATURALIST.

The work of Harger on the Isopoda of New England, Herrick on the Minnesota Entomostraca, and Smith on the New England Decapoda, have been already noticed in the NATURALIST, and hence need not be referred to again. Mr. Kingsley has contributed several short notes and reviews in the various numbers

[1] Description of *Lucifer typus* M. Edw.? Chesapeake Zoölogical Laboratory; Scientific results of the Session of 1878, pp. 113–119, Pl. VII, 1879.

[2] Description of a new species of Chirocephalus. Proc. Academy of Nat. Sci., Philadelphia, 1879, pp. 148–149.

[3] Description of a new Branchipod, l. c., 1879, pp. 200–202.

[4] AMERICAN NATURALIST, XIV, p. 53 (1880).

[5] AMERICAN NATURALIST, XIII, 128, and *Annals and Mag. Nat. His.*, III, 459.

[6] Zoölogy for Students and General Readers, N. Y., 1879.

of this journal, while in his paper on Decapoda,[1] he describes as new, eight species, *Microphrys error* and *Callinectes dubia* from the west coast of America, and *Mithraculus hirsutipes*, *Mithrax trispinosus*, *Lambrus granulatus*, *Panopeus packardii*, *Pilumnus dasypodus* and *P. melanacanthus* from Florida. Notes are given on *Anaptychus cornutus*, *Mithraculus areolatus*, *Mithrax triangulatus*, *Panopeus affinis*, *P. purpureus*, *Xantho 9-dentatus*, *Chlorodius fisheri*, *Pachygrapsus transversus*, *P. gracilis* and *Calappa convexa*.

In anatomy almost no work has been done. Dr. Packard in his Zoölogy, gives a résumé of the structure of the Crustacea, but the additions to our knowledge of these animals is slight. A figure is given showing the differences between the eyes and brain of the blind craw-fish (*Cambarus pellucidus*) and another species with well developed eyes. A brief account of the visceral anatomy of *Serolis* is given, to which we must take exception, it being erroneous in several particulars. The writer contributed to the same work, figures of the nervous anatomy of *Idotea irrorata* and of *Serolis*, but they show no important differences from similar figures of other species of Isopoda.

It is in embryology that the valuable portion of American work on the crabs has been done, and here we have to record three papers on the development of these animals; two by Dr. Faxon and one by Dr. W. K. Brooks. Dr. Faxon in his first paper[2] gives figures showing the later egg-stages and the first stage after hatching of *Hippa talpoida*, so that with the previous paper of Prof. Smith on the same subject,[3] we have a nearly complete life history of this species. In the first egg stage observed, the labrum, both pairs of antennæ, the mandibles and the telson are outlined (the "nauplius" stage). Both pairs of maxillæ and the first two pairs of maxillipeds appear previous to hatching, and in the first zoea stage no other appendages are indicated, but those mentioned acquire a greater development. The abdomen consists of four joints without appendages and the telson resembles somewhat strongly that of a larval shrimp. The gills are yet lacking, and although able to see the other vessels distinctly, our author could not discover the hepatic artery. Dr. Faxon

[1] Notes on North American Decapods. Proc. Boston Soc. Nat. Hist., XX, pp. 145–160, 1879.

[2] On some young stages in the development of *Hippa*, *Porcellana* and *Pinnixa* Bulletin of the Museum of Comp. Zoölogy, v, pp. 253–268, pls. I–V (June, 1879).

[3] Transactions of the Connecticut Academy, III, pp. 311–342, pls. 45–48 (1877).

next discusses the growth of *Polyonyx macrocheles.* The last stages of the zoea obtained at Newport showed the enormously elongate spines of the carapax characteristic of the young of the porcelain crabs. All of the cephalothoracic appendages were present, the first two pairs of maxillipeds being large, biramose (schizopodal) and adapted for swimming. The third maxillipeds were rudimentary, and the ambulatory feet curled under the carapax. Six gills were noticed. The abdomen had six joints, and in the telson of those about to moult could be seen outlined the lacking segment with its appendages. From this stage the crab emerged at a moult without the intervention of a megalops stage. The young crab is nearly orbicular, and has not that "breadth of beam" characteristic of the adult, but resembles rather the genus *Pisosoma* of Stimpson. A bibliography of the embryology of the Porcellanidæ is given, but we notice that the figures of Guerin (in Ramon de la Sagra's Historia fisica, etc., de l'Ile de Cuba, Paris, 1857) are not mentioned. The last species in the present paper is *Pinnixa chætopterana*, which in the last zoeal stage has four long spines, one rostral, one dorsal and one from each postero-lateral angle of the carapax, arranged much as in the oft-copied figures of the zoea of *Carcinus mœnas.* The cephalothoracic appendages have acquired a more or less complete development, the last six, however, being concealed much as in *Polyonyx.* From this stage the crab develops directly, the young, however, not having the enlarged fourth pair of feet which characterize the genus, though the family characters are recognizable. In a supplementary note it is stated, on the authority of Prof. Smith, that a second species of *Pinnixa* found on the New England coast passes through a megalops stage.

The same author has worked out more completely the development of the common prawn of our coast,[1] and his paper forms a marked exception to the general poor quality of American biological work. In this species the cleavage of the yolk occurs in two planes almost synchronously, producing four cleavage spheres, from which the segmentation progresses regularly until the morula stage is reached. No polar vesicles were observed. The gastrula condition was discovered within twenty-four hours, but concerning the origin of the hypoblast we are told nothing.

[1] On the Development of *Palæmonetes vulgaris.* Bulletin Mus. Com. Zoöl., v, pp. 303–330, pls. I–IV (Sept., 1879).

The gastrula mouth soon closed. The first parts of the embryo to appear are the labrum, two pairs of antennæ, the mandibles and the abdomen, the latter very near the former position of the gastrula mouth. These parts appear almost simultaneously. Four days later both pairs of maxillæ and the first pair of maxillipeds have budded; in seven, the two remaining pairs of maxillipeds have appeared, all appendages showing a biramose character. The growth goes regularly on, the yolk being gradually absorbed, the eyes appearing at first as patches of dark pigment,[1] and when the prawn hatches there is a small simple eye at the base of the rostrum, the eyes proper are supported on short pedicels, the antennulæ are simple, the antennæ biramose, the future scale being much larger than the flagellum, the mandibles at no stage possess palpi. The scaphognathite (gill bailer) is in constant motion, though no gills are yet present. The three pairs of maxillipeds are two-branched, and their basal joints act as jaws, reminding one, as Dr. Faxon says, of the manducatory apparatus of *Limulus*. The ambulatory feet are represented by only two pairs of double sacks, the other three being undeveloped. The abdomen is six-jointed and without a trace of appendages. A moult brings two more ambulatory feet, and with the next exuviation the second antennal flagellum appears and the abdomen has seven joints, the sixth with its appendages appearing. After another moult two of the basal rostral teeth appear, the third pair of ambulatory feet acquire a natatory character, and the fourth and fifth pairs as well as the abdominal feet have budded. With two more moults the animal has acquired all its swimming feet, but differs from the Schizopoda (*Mysis*) in having the last pair simple, the exopodite being absent. In two or three more exuviations the exopodites are reduced to simple styles, and after a few more, the shrimp, then about eight millimetres long, acquires essentially the characters of the adult. Rostral teeth, however, continue to be added with growth.

Succeeding this account, summarized above, Dr. Faxon gives a critical review of the literature of the development of *Palæmon*, and we think him right in disagreement with Mr. Spence Bate regarding the homologies of the three pairs of appendages which appear first in the Crustacean embryo.

[1] I would here quote the foot-note on p. 308: "The development of the eye certainly lends no countenance to the idea that its stalk is an appendage homologous with the antennæ, etc."

The development of *Squilla*, by Dr. W. K. Brooks,[1] concludes our notice of the literature of American Crustacea for 1879. While the successive stages in the development of *Palæmonetes* were in most cases the result of the moulting of the larvæ in confinement, Dr. Brooks had to depend more upon the results of surface skimming for his younger stages, and hence his paper, though of great value, lacks the completeness of the last noticed one of Dr. Faxon. The first stage observed was that which formed the genus *Alima* of the earlier systematists; the eyes, both pairs of antennæ, mandibles, maxillæ and first two pairs of maxillipeds being present, the second pair possessing something of the raptorial character found in the adult. The eighth to tenth segments (9–11 Brooks) are differentiated, the eleventh to thirteenth (12–14 Brooks) are still united and all are without appendages. The abdomen consists of six joints, of which four bear appendages; the carapax with its long spines resembles somewhat that of the Decapod zoea. In the next stage the thoracic segments are all free. The third stage observed represents the changes of at least two moults, the remaining thoracic and fifth abdominal appendages being represented by small buds. The next form figured has the carapax and telson somewhat like those of the adult, while the appendages are all present, those of the abdomen, judging by the figures, having assumed something of their adult branchial character.

I would here return thanks to the various authors mentioned for copies of their papers.

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THE STRUCTURE OF THE EYE OF TRILOBITES.

BY A. S. PACKARD, JR.

BEYOND the fact that the entire eye of certain Trilobites, and enlarged views of the outer surface of the cornea of the eye, have been described and figured in Burmeister's work on the organization of Trilobites and in various palæontological treatises in Europe and North America, especially by Barrande in his great work on Trilobites, I am not aware that any one has given a description of the internal structure of the hard parts of the eye of Trilobites.

[1] Larval stages of *Squilla empusa*. Chesapeake Zoölogical Laboratory. Scientific Results of the Session of 1878, pp. 143–170, pls. 9–13 (1879).

The full bibliography of treatises relating to these animals in Bronn's Die Classen und Ordnungen des Thierreichs, carried up to 1879 by Gerstacker, contains references to no special paper on this subject, and the résumé by Gerstacker of what is known of the structure of the eye, only refers to the external anatomy of the cornea, the form of the facets and their number in different forms of Trilobites. He shows that observers divide them into simple and compound; the former (ocelli) are found in the genus *Harpes.* These "ocelli" are said to be situated near one another, and are so large that the group formed by them can be seen with the unaided eye; the surface of the single "ocellus" appears, under the glass, smooth and shining. From the description and the figure of the eye enlarged, from Barrande, it would seem as if each eye was composed of three large simple ones; so that these eyes are really aggregate, and not comparable with the simple eye or ocellus of Limulus and the fossil Merostomata.[1] Moreover the situation of these so-called ocelli is the same as that of the compound eyes of other Trilobites.

The Trilobites with compound eyes are divided into two numerically very dissimilar groups; the first comprising Phacops and Dalmanites alone, and the second embracing all the remaining Trilobites, excepting of course the eyeless genera, Agnostus, Dindymene, Ampyx and Dionide. The eyes of Phacops and Dalmanites are said by Quendstedt and Barrande not to be *compound* eyes in the truest sense, but *aggregated* eyes (*Oculi congregati*). But judging by Barrande's figures of the eyes of *Phacops fecundus* and *P. modestus* (Barrande, Vol. 1, Suppl. Pl. 13, Figs. 12 and 22), and our observations on the exterior of the eye of an undetermined species of *Phacops*, kindly sent us by Mr. J. F. Whiteaves, Palæontologist of the Canadian Geological Survey, we do not see any essential difference between the form and arrangement of the corneal lenses of Phacops and Asaphus, and are disposed to believe that the distinctions pointed out by the above named authors are artificial.

For my material I am mainly indebted to Mr. C. D. Walcott, who has so satisfactorily demonstrated the presence in Trilobites of jointed cephalo-thoracic appendages. On applying to him for specimens, and informing him that I wished to have sections

[1] The eyes of the fossil Merostomata (Eurypterus and Pterygotus) are evidently in external form and position, judging by Mr. Woodward's figure, exactly homologous with the ocelli and compound eyes of Limulus.

made of the eyes of Trilobites to compare with those of Limulus, he very generously sent me his own collection of sections of the eyes of *Asaphus gigas* and *Bathyurus longistrinosus*, which he had prepared for his own study, also other eyes, and especially the shell or carapace of a large Asaphus, from Trenton Falls, showing the eye and the projecting points of the corneal lenses. Prof. Samuel Calvin kindly sent me the eyes of an unknown Trilobite from the Trenton limestone, one specimen showing the pits made in the mud by the projecting ends of the corneal lenses, while to Mr. Whiteaves I am indebted for a well preserved eye of Phacops. To Dr. C. A. White, Palæontologist of the U. S. Geological Survey, I am also indebted for eyes of Calymene.

First turning our attention to the casts and natural sections; that of the interior of the carapace, including the molted cornea of *Asaphus gigas*, is noteworthy. When the concave or interior

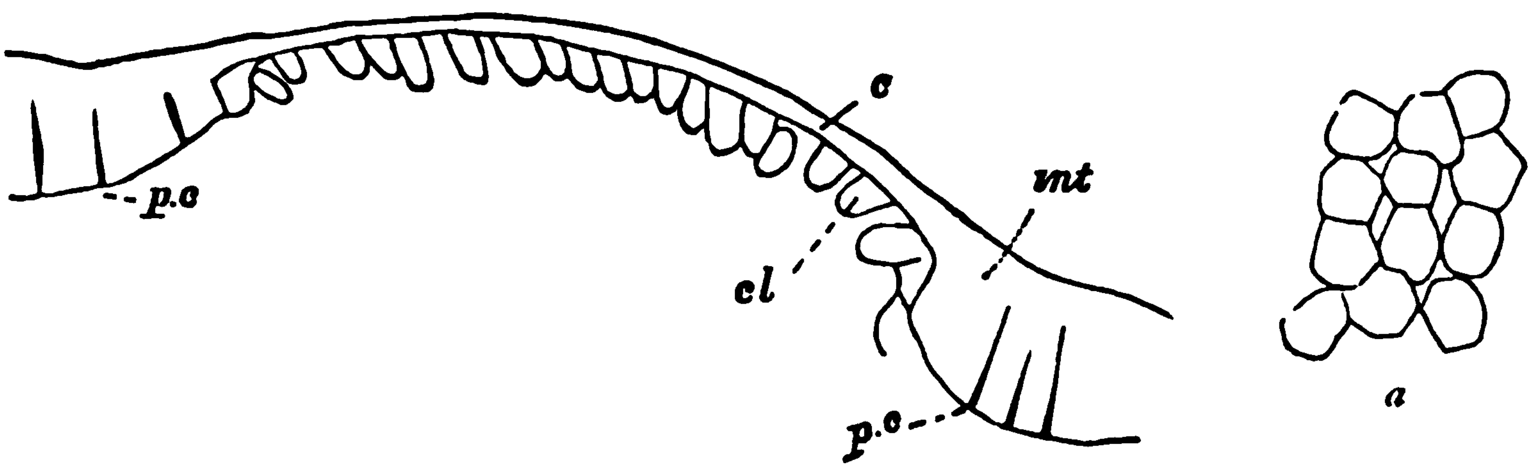

FIG. 1.—Section of hard parts of eye of Limulus; *c*, cornea; *int*, integument: *pc*, pore canals; *cl*, corneal lens. × 30 diams. FIG. 1*a*, optical section of facets.

surface of this specimen is placed under a magnifying power of fifty diameters, the entire surface is seen to be rough with the ends of the minute solid conical corneal lenses which project into the body-cavity. This is exactly comparable with the cast shell of Limulus and its solid corneal lenses projecting into the body cavity (Fig. 1). Those of Asaphus only differ in being much smaller and more numerous, and perhaps rather more blunt. Without much doubt the ends of the corneal lenses of Asaphus, as in Limulus, were enveloped in the retina, the animal molting its carapace, the hypodermis with the retina being retained by the trilobite, while the corneal lenses were cast with the shell.

In the specimen of the unknown trilobite from Iowa, received from Prof. Calvin, the corneal lenses, seen externally, are quite far apart, arranged in quincunx order; the lenses are round and decidedly convex on the external surface. In a natural section, where the

eye has been broken into two, the conical lenses are seen to extend through the cornea as cup-shaped or conical bodies, and are quite distinct from the cornea itself. In another broken eye of the same species, the cornea is partly preserved, and two of the corneal lenses are seen to extend down into and partially fill two hollows or pits; these pits are evidently the impressions made in the fine sediment which filled the interior of the molted eye or cornea!

Thus in the *Asaphus gigas* noticed above, we have the entire inside of the cornea with the cone-like lenses projecting from the concave interior; while in the last example we have the impressions made by the cones in the Silurian mud which silted into the cornea after the trilobite had cast its shell.

Farther evidence that the trilobite's eye was constructed on the same pattern as that of the living horse-shoe crab is seen in the sections made by Mr. Walcott. We will first describe, briefly, the eye of Limulus. Fig. 1 represents a section through the cornea of Limulus; *c*, the cornea, which is seen to be a thinned portion of the integument; *pc*, indicates one of the nutrient or pore canals, which are filled with connective tissue extending into the integument from the body cavity; *cl*, is one of the series of solid conical corneal lenses. These are buried partly in the black retina, and the long slender optic nerve just before reaching the eye subdivides, sending a branch to each facet or cornea, impinging on the lens. Fig. 1*a* represents a vertical view of the corneal lenses or facets, magnified fifty diameters, as seen through the transparent cornea. It will be seen that they are slightly hexagonal and arranged in quincunx order; their external surface is flat, though that of the ocelli is slightly convex.

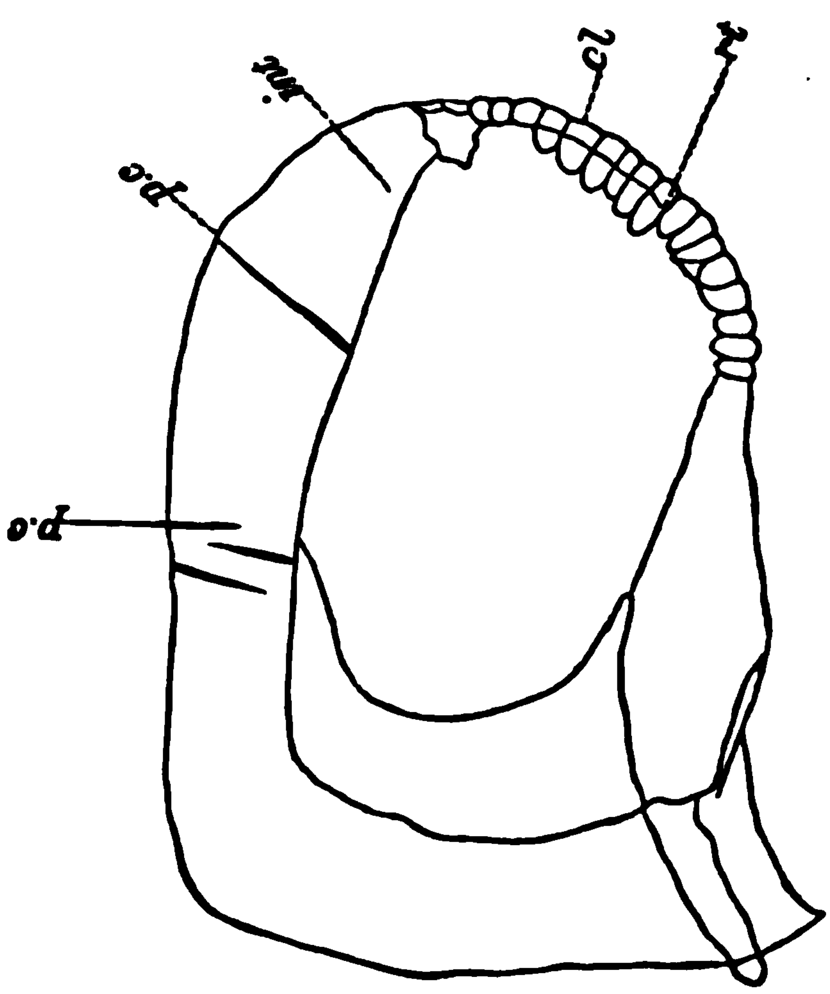

FIG. 2.—Section through the eye of a trilobite; lettering as in Fig. 1. × 50 diams.

Now if we compare with the horse-shoe crab's eye that of the

trilobite (*Asaphus gigas*, Fig. 2), we see that the eye is raised upon a tubercle-like elevation of the carapace; the integument (*int*) is about as thick as that of Limulus, and it contains similar pore-canals (*pc*); the eye itself, or cornea, occupies a rather small area; its exterior surface, instead of being smooth as in Limulus, is tuberculated, or divided up into minute convex areas; these convexities are the external surfaces of the corneal lenses, which extend through the cornea, so that its surface is rough instead of smooth as in Limulus; *cl* indicates one of the corneal lenses which are arranged side by side; they are of slightly different lengths and thicknesses, and the rather blunt free ends project into the cavity of the eye, which in the fossil is filled with a translucent calcite.

It is quite apparent that we have here the closest possible homology between the hard parts of the eye of Limulus and the Asaphus. Another point of very considerable interest is a tolerably distinct dark line (*rt*) which seems to run across from one lens to another, and which may possibly represent the external limits of the retina or pigment mass in which the ends of the lenses were probably immersed; should this be found to be the indications of the outer edge of the retina, it would be a most interesting fact in favor of our view of the identity between the eyes of the two types of *Palæocarida* under consideration.

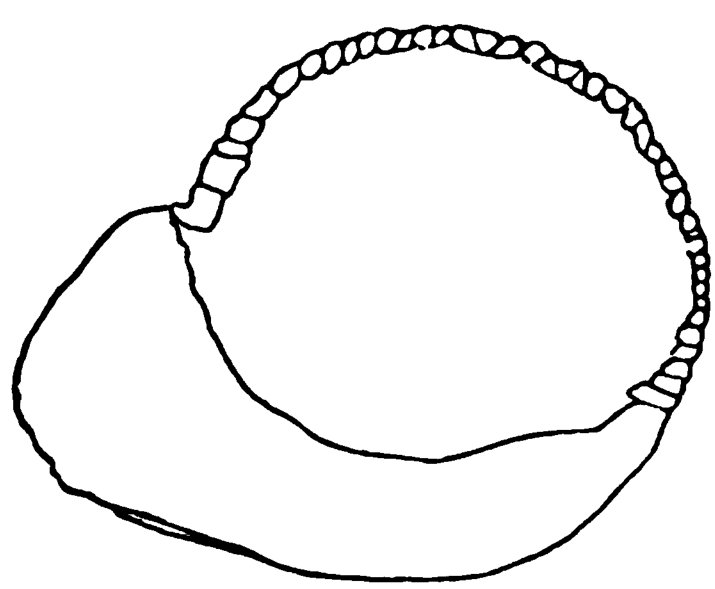

FIG. 3.—Cornea of Asaphus.

Another section sent us by Mr. Walcott is represented by Fig. 3; it is from *Asaphus gigas*, but represents a less elevated and broader part of the eye than that seen in Fig. 3; the section does not so well exhibit the free ends of the corneal lenses. Fig. 3 *a* represents a transverse view of the eye of *Asaphus gigas*, showing the hexagonal form of the facets, and their quincunx arrangement.

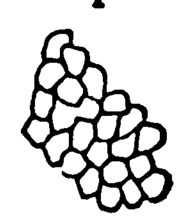

FIG. 3*a*.

This hexagonal appearance of the corneal lenses is still retained in natural vertical sections of eyes of the same genus; where with a good Tolles lens the sides of the cones are seen to be angular. Fig. 4 represents a few such cones. I do not understand to what this hexagonal appearance is due; for both in

Limulus and the Trilobites the corneal lenses appear usually to be round, and yet in making a camera drawing (as are all those here represented) of the cornea of Limulus from above, they present the same hexagonal appearance as in the Trilobites. The cause of this I leave to others to explain.

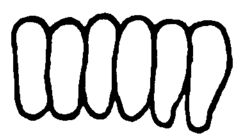

FIG. 4.—Lenses of Asaphus.

In a section (transverse) of the cornea of *Bathyurus longistrinosus*, received from Mr. Walcott, the lenses are seen to be very irregular, five or six-sided, and very irregularly grouped, not arranged in distinct rows.

From the facts here presented it would seem evident that the hard parts of the eye of the Trilobites and of Limulus are, throughout, identical. The nature of the soft parts will, as a matter of course, always remain problematical; unless the dark line indicated in Fig. 3 *(cl)* really represents the outer edge of the pigment of the retina; but however this may be, judging by the identity in structure of the solid parts, we have, reasoning by analogy, good evidence that most probably the eye of the Trilobites had a retinal mass like that of Limulus, and that the numerous small branches of the long slender optic nerve (for such it must have been) impinged on the ends of the corneal lenses. It has been shown by Grenacher and myself that the eye of Limulus is constructed on a totally different plan from that of other Arthropods; I now feel authorized in claiming that the trilobite's eye was organized on the same plan as that of Limulus; and thus when we add the close resemblance in the larval forms, in the general anatomy of the body-segments, and the fact demonstrated by Mr. Walcott that the Trilobites had jointed round limbs (and probably membranous ones), we are led to believe that the two groups of Merostomata and Trilobites are subdivisions or orders of one and the same sub-class of Crustacea, for which we have previously proposed the term *Palæocarida*.

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RECENT LITERATURE.

THE GEOLOGY OF WISCONSIN.[1]—This bulky report has not only a handsome typographical appearance, but is well illustrated by numerous excellent plates, and an atlas of maps. It bears every appearance of care and labor in its preparation, and of containing

[1] *Geology of Wisconsin, Survey of* 1873–1879. Vol. III, Accompanied by an Atlas of Maps. J. C. Chamberlain, Chief Geologist. Madison, Wis., 8vo. pp. 763.

a great mass of information, not only useful to the people of Wisconsin, but also of interest to geologists in general. It embraces chapters on the general geology of the Lake Superior region, by R. D. Irving; on the lithology of the Keweenawan or copper-bearing system, by R. Pumpelly; on the geology of the Eastern Lake Superior district, by R. D. Irving; on the Huronian series, west of Penokee gap, by C. E. Wright; on the geology of the Western Lake Superior district, by E. T. Sweet; on the geology of the Upper St. Croix district, based on the notes of the late Moses Strong, and edited by T. C. Chamberlain; on the geology of the Menominee region, by T. B. Brooks; and lastly on the geology of the Menominee Iron region. The volume is noteworthy from the valuable contributions to lithology, illustrated by numerous colored plates, and to the mining interests of the State, *i. e.*, the Huronian iron-bearing and the Keweenawan or copper-bearing rocks, these portions being well illustrated by maps.

MR. KINGSLEY ON THE CRUSTACEA BELONGING TO UNION COLLEGE[1].—In this paper 103 species are noticed, two new genera (*Eupilumnus* and *Concordia*) are described, the genus *Heteractæa* of Lockington is recharacterized, and the name *Miersia* is proposed for *Ephyra*. The new species described are *Actæa spinifera*, *Eupilumnus websteri*, *Lithadia lacunosa*, *Pisosoma glabra*, *Concordia gibberosus*, *Alpheus websteri*, *A. packardii*, *Ozyris alphærostris* and *Pontonia unidens*. On the plate which accompanies the article, nine species are figured, seven of which belong to the genera Pisosoma, Eupilumnus, Euceramus, Concordia, Thor, Ozyris and Tozeuma, representations of which have never before been illustrated. All known genera of the Caridea of Dana are briefly characterized.

CROSBY'S GEOLOGY OF EASTERN MASSACHUSETTS.[2]—The Boston Society of Natural History, besides its Memoirs and Proceedings, has undertaken the publication of volumes entitled "Occasional Papers." The first was the Correspondence of Dr. Harris, the Entomologist; the second, Hentz's Spiders of the United States, and now it gives us the results of five years labor by Mr. Crosby, as assistant in the Museum, on the crystalline and primordial rocks of Eastern Massachusetts, a subject of high interest and of a good deal of difficulty. The introduction gives a general sketch of the topography and geographical features of that part of New England surrounding the Gulf of Maine. The result of the author's labors

[1] *On a collection of Crustacea from Virginia, North Carolina and Florida, with a revision of the genera of Caryonidæ and Palæmonidæ.*—Proc. Acad. Nat. Sci. Phila. 1879. pp. 383–427.

[2] *Occasional Papers of the Boston Society of Natural History.* III. Contributions to the Geology of Eastern Massachusetts. By WILLIAM O. CROSBY, Boston, 1880. Published by the Society. $3.00. 8vo, pp. 286, with an atlas and five plates of sections, &c.

is to bring out at least much more clearly than has before been done, the fact that between the crystalline and the oldest primordial rocks, "there is a great chronologic break, a 'lost interval' of immense duration," and also that the geological formations are oldest on the sea-board, becoming successively newer as we proceed from Massachusetts bay to the Berkshire hills in the western part of the State. Bearing these two points in mind, the volume will be read with much interest, afford food for further discussion, and doubtless will lead local geologists to a more careful study of their neighborhood. The region here treated of is most difficult to study and understand; a flood of light has been thrown upon the subject by Mr. Crosby, and many facts which will be of constant use in future discussions are here recorded. The map especially is an excellent graphic résumé of the subject. It is not often the case that a city society does so much as the one at Boston to promote the study of local geology, in this respect it has set a most useful example to similar organizations.

BROOKS'S DEVELOPMENT OF THE OYSTER.[1]—This is the first attempt to scientifiically examine our oyster, its breeding habits and mode of development; the result is a valuable addition to our knowledge of the American oyster, and a fresh discussion of the embryology of mollusks. Dr. Brooks shows that our species, like the European, is bisexual during the breeding season, and that the general mode of development, is like that sketched out by Lovén in his studies of the development of Cardium, a bivalve mollusk.

Unlike the European species, the eggs of the American oyster undergo development in the open sea, not within the shell. The process of segmentation is remarkable for its great rapidity, for the bilateral symmetry of the germ at this period, and for the well marked alternation of periods of activity with periods of rest. The ciliated germ is formed in some cases within two hours after fertilization, but twenty-four hours is the usual time, and it may sometimes require two days to reach it. There is an invaginate gastrula state, the primitive opening (blastopore) closing completely, the shell appearing at the point which the blastopore previously occupied, while directly opposite the position of the blastopore, the mouth and then the anus of the digestive tract make their appearance. The Veliger has the general form of that of Cardium and other Lamellibranchs.

Dr. Brooks thinks that the embryology of the oyster bears out his view that Lamellibranchs must be regarded as a side branch from the main molluscan stem, of which the Gasteropods are a much more direct continuation, "and that all attempts to trace the phylogeny of the higher Mollusca through the Lamellibranchs to

[1] *Johns Hopkins University, Baltimore. Studies from the Biological Laboratory, The Development of the Oyster.* By W. K. Brooks. No IV. Baltimore, 1880. 8vo. pp. 84. 11 plates.

lower invertebrates, are erroneous and useless." We would allow this, but none the less, in our view, are the Lamellibranchs a lower, less specialized division of mollusks, than the Cephalophora and their gasteropod representatives.

The memoir on the oyster is succeeded by a brief discussion on the acquisition and loss of a food-yolk in molluscan eggs.

THOMAS'S CHINCH BUG.[1]—In this Bulletin, Professor Thomas has given the leading known facts regarding the ravages of the chinch bug, in the western corn growing States, and has collected the different views of entomologists as to the best means of prevention. The author shows by a lengthy series of statistics, that corn is injured much more than wheat. Enough for practical purposes is stated regarding the form and habits of this destructive pest, and as a brief manual, showing the best means of preventing its attacks, the pamphlet is timely, and will prove most useful to western farmers. The edition of 2000 copies issued by the Department of the Interior, was at once exhausted, and a new and much larger edition has been ordered by Congress. This is an evidence of the demand throughout the country for accurate information concerning this injurious insect, of the great need of careful, widely extended and comparative studies upon the other more destructive forms, and the wide diffusion of such knowledge among those most interested.

THE GEOLOGIGAL RECORD.[2]—This valuable publication is again before us, and we bespeak for it the support of geologists and scientific men generally. Publications of this character are necessary for the student, and hence to the progress of science. They are not published for profit, and their editors are chiefly rewarded by a sense of their usefulness. While we congratulate the editor of the *Geological Record* on the general result of his work, we must encourage some of his collaborators to a little more care in some important details. Thus (p. 279) it is stated that among the "new" species of *Mammalia* described in the quarto report of Lieut. Wheeler, is "an undeterminable species of *Protohippus*!" Same page, bottom, it is stated that a paper "describes the generic characters of *Erisichthe*, adding specific descriptions," etc. "No age or locality given." The paper quoted states that the genus and one of the species are from the Niobrara Cretaceous of Kansas. Page 280, a list of species is given ending with *Monoclonius crassus*, which are said to be "new species founded on *Dinosaurian* teeth." The *M. crassus* was, as stated in the paper,

[1] *Department of the Interior, United States Entomological Commission, Bulletin No. 5. The Chinch Bug: its history, character and habits, and the means of destroying it or counteracting its injuries.* By Cyrus Thomas, Ph.D., Washington, 1879. 8vo, pp. 44, with a map.

[2] *The Geological Record for* 1877, *with supplements for* 1874–5. Edited by W. WHITTAKER, F.G.S. London, Taylor & Francis.

founded on a nearly complete skeleton. Under *Hedronchus sternbergi*, the recorder isolates the remark of the author that the typical specimen "has the appearance of the crown of a young tooth," thus conveying the impression that the author described it believing it to be such This is really culpable carelessness. Page 281; *Tichosteus lucasanus* is said to have been founded on teeth; its teeth are really unknown. *Clepsydrops limbatus* is said to be from the Dakota beds of Colorado; it is described from the Texas Permian. Same page; "A (?) crocodilian tooth named *Suchoprion cyphodon*;" the text of the paper quoted states in several places that several teeth represent this species. Page 290, *Diceratherium* is called "the Eocene rhinoceros" The American species are Miocene. Page 291, "The beds this fossil ('Atlantosaurus') comes from are Jurassic and Cretaceous " No genus of reptiles is known to be common to the Jurassic and Cretaceous in America, least of all the one in question.

THE MIDLAND NATURALIST.[1]—Twenty-four monthly numbers of this valuable journal have been published for the years 1878-9. It represents the scientific activity of twenty-four scientific societies or field-clubs of the Midland Counties of England. The contributions embrace some of the best known names in natural history in England, as Allport, Cobbold, Gosse, Jeffreys, Whittaker, Woodward, &c. The discovery of specimens of animals previously unknown to England by members of the societies, and first published in this journal, is a matter of interest. Much that is of local interest and much new matter will be found in its pages, with a full synopsis of the proceedings of the various societies.

ROCKY MOUNTAIN HEALTH RESORTS[2]—This is a thorough work on the sanitary conditions presented by the high altitudes of Colorado and its vicinity, by an enthusiast in this study. Dr. Denison has been pursuing his studies in this direction for several years. He is a practicing physician at Denver, Colorado. He has produced a real monograph on the subject which ought to prove of great service to our people visiting the Rocky Mountain region in search of health or rest. The book is well illustrated with maps, diagrams and tables, and the observations are systematically and clearly arranged. Consumption in all its aspects is treated in detail, as indeed all forms of pulmonary diseases.

PROCEEDINGS OF THE DAVENPORT ACADEMY OF NATURAL SCIENCES.—The second part of the second volume of this enterprising society evinces the same energy and self-sacrifice which

[1] *The Midland Naturalist.* The Journal of the Associated Natural History, Philosophical and Archæological Societies and Field Clubs of the Midland Counties. Edited by E. W. BADGER and W. J. HARRISON, F.G.S. Birmingham, England.

[2] *Rocky Mountain Health Resorts.* An analytical study of high altitudes in relation to the arrest of chronic pulmonary diseases. By CHARLES DENISON, M.D. pp. 192.

has characterized the history of this academy, now in the thirteenth year of its existence, and which merits especial mention. The volume is strong in archæological papers, by W. W. Calkins, W. H. Pratt, A. D. Churchill, J. Goss, Dr. R. J. Farquharson; these will be noticed more particularly in our department of Anthropology. Among zoölogical papers is Mr. Calkin's catalogue of the marine shells of Florida, with descriptions of several new species, and papers by Mr. H. Strecker, on the Bombycid moths, and an interesting account by him of hybrids between *Callimorpha lecontei* and *C. interrupto-marginata*. There are palæontological articles by S. A. Miller and W. H. Barris; but without disparagement to the other articles that by Mr. J. Duncan Putnam on certain bark lice called *Pulvinaria*, is of the more importance, from the careful manner in which the anatomy, internal and external, the development and metamorphosis of this singular insect have been discussed. This bark louse has attracted attention from the injury it has done to maples East, and especially West, and Mr. Putnam suggests various remedies. The crowded plates are drawn with care, and engraved by the author, and considering this is his first attempt, are well enough done.

HAYDEN'S GREAT WEST.[1]—This pamphlet while very popular in its treatment, is authoritative, written as it has been by one who has closely studied for over twenty years the physical geography, topography and geology of the Far West, and has had perhaps greater facilities at his command than any other geologist. After giving a brief history of the different surveys of the West, the mountain systems of the Cordilleras are described, followed by an account of the Yellowstone river and its tributaries, the Yellowstone park, and its geysers, the principal rivers of the Northwest, viz.: the geographical area drained by the Missouri river and its tributaries. Accounts of the tertiary lake-basins of the West with their numerous vertebrate fossils, are succeeded by those of the Snake river, its lava plains, the American and the Shoshone falls; and farther on the plateau of Colorado, with its high mountain peaks, and the Indian ruined towns and cave dwellings of the Southwest are noticed. Then passing westward over the Great basin, Great Salt lake is described, and finally the Sierra Nevada and the coast range, while the brochure ends with a brief account of the mineral wealth of the West, the fossils of the lignite, and lastly the stock-raising industry of the Western plains. The whole is the most interesting and reliable summary of the more striking features of the West that we have yet seen.

[1] *The Great West: its Attractions and Resources.* Containing a popular description of the marvelous scenery, physical geography, fossils and glaciers of this wonderful region, and the recent explorations in the Yellowstone park, "the wonderland of America." By Prof. F. V. HAYDEN, LL.D. Being an article written for a work entitled, "The Great West." Philadelphia, Franklin Publishing Company, 1880, 8vo, pp. 87.

VERRILL'S CEPHALOPODS OF NORTHEASTERN AMERICA.[1]—Very considerable interest is attached to the subject here discussed, owing to the fact that upon the European coasts there have been from time immemorial myths and legends concerning such sea monsters, all of which have passed under the name of "Kraken." Of late years these colossal cuttle fish have been stranded on the shores of Newfoundland, or captured by fishermen in adjoining waters, more commonly than on the European coast, and thus while we have no traditions of Krakens, we have been favored with a greater number of veritable specimens than the naturalists of the Old World. Prof. Verrill has been as fortunate as industrious in following up every trace and fragment of these large squids, and his numerous shorter contributions have resulted in the elaborate and detailed monograph before us. There are probably only three distinct forms among the large Newfoundland specimens of Architeuthis, and the author thinks that two of these may be merely the two sexes of one and the same species. The genus Architeuthis appears to be closely allied to Ommastrephes, the calamary. The paper bears evident marks of care and painstaking accuracy.

RECENT BOOKS AND PAMPHLETS.—Brainwork and Overwork. By H. C. Wood. 12mo, pp. 126, 1880. From the author.

Valedictory address of the graduating class of the Women's Medical College of Pennsylvania. By Francis Emily White, M.D. 8vo. pp. 16. 1880. From the authoress.

The American Bookseller. Vol. IX, No. 10, May 15, 1880. 8vo. From the publishers.

Observations upon the habits, structure and development of Amphioxus lanceolatus. By Henry J. Rice, S.B. (AM. NAT., Jan. and Feb., 1880.) 8vo, pp. 38, 2 pls. From the author.

The geological antiquity of Insects. By Herbert Goss. (From Vols. XV and XVI Ent. Month. Mag.) 8vo, pp. 50. 1880. From the author.

Geology of the provinces of Canterbury and Westland, New Zealand. By Julius von Haast. 8vo, pp. 486, pl., 1880. From the author.

Manual of the Indigenous Grasses of New Zealand. By John Buchanan. 8vo, pp. 175, pl. 61, 1880. From the author.

Man's place in Nature. By Joseph Le Conte. (Art. No. 10 from the Princeton Rev.) 8vo, pp. 23, 1880. From the author.

A catalogue of the official reports upon Geological Surveys of the United States and Territories, and of British America. By Fred. Prime, Jr. (From Vol. VII Trans. Amer. Inst. Min. Engineers.) 8vo, pp. 71, 1879. From the author.

Ethylization: the anæsthetic use of the Bromide of Ethyl. By R. J. Levis, M.D. (From the Med. Rec.) 8vo, pp. 8. From the author.

The numeral adjective in the Klamath language of Southern Oregon. By Albert S. Gatschet. (From Amer. Antiq., Vol. II, No. III.) 8vo, pp. 8.

The Spotted Salamander. By S. P. Monks. (From the Amer. Nat., May, 1880.) 8vo, pp. 3. From the authoress.

[1] *The Cephalopods of the North-eastern Coast of America.* Part I. The gigantic Squids (Architeuthis) and their allies, with observations on similar large species from foreign localities. By A. E. VERRILL. (From the Transactions of the Connecticut Academy of Sciences, vol. V, New Haven, March, 1880) 8vo, pp. 177–257, 13 plates.

General Guide to the Museum of the Boston Society of Natural History. By Alpheus Hyatt. I. Introduction. 12mo, pp. 26, 1 chart, 1880. From the society.

The eleventh annual Report of the American Museum of Natural History, New York. 8vo, pp. 32, 1880. From the museum.

Syllabus of courses of lectures and instruction in General Geology, with reference to sources of information. By Alex. Winchell. 8vo, pp. 42, 1879. From the author.

Report of the Board of Commissioners Seventh Cincinnati Industrial Exposition. 8vo, pp. 408, 1879. From the Board.

Twelfth and thirteenth annual reports of the Trustees of the Peabody Museum of American Archæology and Ethnology. Vol. 2, Nos. 3 and 4., 8vo, 1880. From the museum.

Journal of the Cincinnati Society of Natural History, Jan. and April, 1880. Vol. II, No. 4, and Vol. III, No. I. From the society.

Archives of Comparative Medicine and Surgery. Vol. I, No. 2, 8vo, April, 1880.

Proceedings of the Boston Society of Natural History. Vol. XX, Pt. III, April, 1879 to Jan. 1880. From the society.

American Journal of Science. May, 1880. From the editors.

On the structure and development of the skull in Lacertilia. Pt. I. On the skull of the common lizards (Lacerta agilis, L. viridis and Zootoca vivipara). By W. K. Parker. (The Croonian lecture.) (From Phil. Trans. Roy. Soc., 1879.) 4to, pp. 45, pl. 8. From the author.

The Geological Record for 1877. Edited by Wm. Whitaker. 8vo, pp. 432, 1880. From the editor.

La Revue Scientifique, Jan. 17, 1880. From the editor.

Illustrations of nests and eggs of birds of the Middle States, with text. By Thos. G. Gentry. Pt. I, 4to, 1880. From the author.

Bulletin Mensuel de la Société d'Acclimatation. 3e Sér., Tome VII, No. I, Jan., 1880. From the society.

Diagnose d'une nouvelle et très petite espèce de Musaraigne de Madagascar. By Dr. E. L. Trouessart. (Ext. Journ. Le Naturaliste.) 8vo, pp. 1, 1880. From the author.

Note sur la Synonymie du genre Tanrec. By E. L. Trouessart. (Ext. du Journ. Le Naturaliste, 1880.) 8vo, pp. 6. From the author.

Note sur Quatre Espèces de Cheiroptères rares ou nouvelles pour la Faune Francais. 8vo, pp. 55. Révision des Musaraignes (Soricidæ) d'Europe et notes sur les Insectivores en Général. By E. L. Trouessart. Ext. Bull. Soc. d'Etudes Scientif. d'Augers, 1880. 8vo, pp. 24. From the author.

On a very small Shrew from Mayotte, Crocidura (Pachyura) coquerelii, Potten and vandam. By E. L. Trouessart. 8vo, pp. 5, 1880. From the author.

Notice sur quelques soudages aux environs de Mulhouse et en Alsace. Par MM. Ch. Zundel et M. Mieg. (Ext. Bull. Soc. Ind. de Mulhouse.) 8vo, pp. 11, 1880. From the authors.

Notes sur Rouchamp. Par M. Mathieu Mieg. (Ext. Bull. Soc. Ind.) 8vo, pp. 12, 1880. From the author.

Mesoplodon bidens, en Tilvæxt til den danske Havfauna. Af J. Reinhardt. (From Oversight d. k. D. Vid. Selsk. Forhdl. 1880.) 8vo, pp. 12. From the author.

Abbildungen von Vogel-Skeleten. Herausgegeben von Dr. A. B. Meyer. 1 Lief. 4to, pp. 8, pl. 10, 1879. From the editor.

Palæontographica. Beiträge zur Naturgeschichte der Vorzeit. Die Flora der Westfälischen Kreideformation. Von Prof. Hosius und Dr. von der Marck. 4to, pp. 241, pls. 44, 1880. From the authors.

Annali del Museo Civico di Storia Naturale di Genova. Vol. XIV, 8vo, 1879. From the museum.

Il Canton Ticino Meridionale ed i Paesi Finitimi Spiegazione del foglio XXIV. Tauf. colorita geol. da Spreafico, Negri e Stoppani per Torquato Taramelli. (Vol. XVII Mat. Carta Geol. Della Soizzera.) 4to, 1880. From the author.

Annales del Museo Nacional de Mexico. Tomo II, Entrega 1a. 4to, 1880.

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GENERAL NOTES.

BOTANY.

EFFECTS OF UNINTERRUPTED SUNSHINE ON PLANTS.—Professor Schübeler has made a series of observations on the effect produced by the almost unbroken sunlight of the short Scandinavian summer, on plants raised from foreign seed, *i. e.*, wheat from Bessarabia and Ohio. The general results are stated by the *Journal* of the Royal Microscopical Society, as follows:—

1. The grain of wheat that has been grown in low-lying lands, may be propagated with success on the high fields, and will reach maturity earlier at such elevations, even, although at a lower mean temperature. Such grain, after having been raised for several years at the highest elevation, which admits of its cultivation, is found, when transferred to its original locality, to ripen earlier than the other crops which had not been moved. The same result is noticeable in grain that has been transported from a southern to a more northern locality, and *vice versâ*.

2. Seeds imported from a southern locality, when sown within the limits compatible with their cultivation, increase in size and weight; and these same seeds, when restored from a more northern locality to their original southern home, gradually diminish to their former dimensions. A similar change is observable in the leaves and blossoms of various kinds of trees and other plants. Further, it is found that plants raised from seed ripened in a northern locality are hardier, as well as larger, than those grown in the south, and are better able to resist excessive cold.

3. The further north we go, within certain fixed limits, the more energetic is the development of the pigments in flowers, leaves and seeds. Similarly, the aroma or flavor of various plants or fruits is augmented in intensity the further north they are carried within the limits of their capacity for cultivation; and conversely, the quantity of saccharine matter diminishes in proportion as the plant is carried further northward.

DESTRUCTION OF INSECTS BY FUNGI.—Prof. Elias Metschnikoff, the distinguished Russian Embryologist, has, according to *Nature*, recently investigated this subject and has given an explanation of the possible value of yeast application more satisfactory than that adopted by Dr. Hagen. The general result of the most accurate investigations of the beer-yeast fungus (*Saccharomyces cerevisiæ*)

is entirely opposed to the notion that it can enter an insect's body, and produce a disease. Metschnikoff has examined other minute fungi, and has by experiment proved their very deadly character to the insects exposed to infection; one of the most destructive is the green muscardine *(Isaria destructor)*. He has cultivated the spores in quantity by the use of beer-mash; in this decoction, the green muscardine produced a rich mycelium and finally spores. Metschnikoff recommended the cultivation of an insect-disease-producing fungus in quantities to places infested by these insects. Will not some of the numerous microscopists in this country make a practical application of this discovery to the destruction of our noxious insects? It might be readily tried this summer on the currant saw-fly worm, or canker worm, tent caterpillar, the potato beetle, or any other destructive insect which can be experimented upon in large numbers near the laboratory.

THE ORIGIN AND SURVIVAL OF THE TYPES OF FLOWERS.—In a lecture delivered before the California Academy of Sciences, October, 1879, Prof. Cope proposed the hypothesis that "the consciousness of plant-using animals, as insects, has played a most important part in modifying the structure of the organs of fructification in the vegetable kingdom. Certain it is that insects have been effective agents in the preservation of certain forms of plants" (AMERICAN NATURALIST, 1880, p. 266). Dr. Hermann Mueller has recently published a book in which he seeks to explain the existing variations in the forms of flowers on the principle of selection. He supposes that insects of different tastes bred peculiar flowers, just as men breed peculiar races of cattle. Carrion-loving insects bred their kind of flowers, and long tongued insects, the tubular kinds, and many other classes of insects have, each class, bred the flowers they love best.

Dr. Mueller is abundantly able to theorize on this subject, and his views, so far as they go, will command the assent of most persons. But like all the Darwinians, he confounds survival or preservation of characters, with the origin of characters. On this subject Prof. Cope has the following (l. c. 266): "I would suggest whether the mutilations and strains they [plant-using animals] have for long periods inflicted on the flowering organs may not, as in some similar cases in the animal kingdom, have *originated* peculiarities of structure."

BOTANICAL NOTES.—Dr. Parry during his explorations in southern California, discovered a handsome new lily, which has been described by Mr. Watson as *Lilium parryi*, in the Proceedings of the Davenport Academy of Natural Sciences, with an excellent plate. The second volume on the botany of California, by Mr. Watson, is now going through the press, and will be published in midsummer.——A revision of the genus *Pinus*, by Dr. Engelman, appears in the Transactions of the Academy of Science of

St. Louis, February, 1880, illustrated by three plates.——In the *Bulletin* of the Torrey Botanical Club, for April, Mr. F. Wolle gives a fourth list of fresh water algæ mostly found in the vicinity of Bethlehem, Pennsylvania, of which at least ninety are new to the United States flora, and a number are described as new to science.——A communication on the "influence of electricity upon the growth of plants," was presented by Mr. J. M. Batchelder, of Boston, to the Club. The author sowed "pepper-grass" seeds on cotton floating on the surface of distilled water contained in two tumblers. One of the tumblers was insulated, and in it was placed a coiled copper wire, the other extremity of which communicated with a revolving belt. Both tumblers were placed under the same conditions of light and heat. It was found that the electricity retarded both the germination of the seeds and the subsequent growth of the plants to a remarkable degree. At the conclusion of his experiments, Mr. Batchelder discovered that while the roots of the plants in the non-electrified water were growing normally, those submitted to the action of electricity were twisted and coiled in an intricate manner among the fibres of the cotton.——A new species of Potamogeton (*P. illinoiensis*) is described by T. Morong, with notes on other species in the *Botanical Gazette*, for May. In the June number, G. Engelman notices the vitality of the seeds of serotinous cones, and E. L. Greene publishes notes on certain silkweeds.

ZOÖLOGY.[1]

THE HERRING OF THE PACIFIC COAST.—The herring fishery is scarcely so important upon the coast as upon those of the Atlantic. How much of this is due to the herrings, and how much to the human inhabitants of the region is hard to tell. The species of Clupea, commonly known here as the herring, *Clupea mirabilis*, is, I believe, smaller than the Atlantic herring, and hitherto the cured fish has not been able to compete with the Eastern article. This, however, is not due to any scarcity of the fish, which occurs in shoals all along the coast at certain seasons, and is always abundant in the more northern regions. The herring found along the coast of the United States are said to be much inferior to those taken between Puget sound and Oonalashka.

Some have been cured in Humboldt bay, but Humboldt herring are said to be very poor. The Alaska Fish Company have put some up at Oonalashka, which, having been very carefully cleaned and prepared, were sold to restaurants and oyster shops for lunch herring, and the Cutting Packing Company salt some at Sitka. The Indians press the whole fish for oil, and the spawn is kept to form part of their winter supply of food.

Besides the herring, we have another Clupea, *C. sagax*, com-

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

monly called the sardine. This species comes into market in small quantities about April, becomes abundant in July and August, and appears occasionally at least as late as the beginning of November. Those brought in in April, May and June are chiefly young fish.

The herring begins to arrive in our markets at the end of September, and will, I am told, be in season during the rainy season. All that are brought to San Francisco are eaten fresh.

The anchovy, *Engraulis ringens*, is exceedingly abundant in this bay, and it is to be wondered at that more persistent efforts have not been made to preserve them, or to make sauce from them.

The "Columbia river sardines" occasionally sold in the shops, are not sardines in any sense. Those I have seen are the Eulachon, *Thaleichthys pacificus*, a small fish of the salmon tribe. The Eulachon is very oily, and probably makes very palatable potted fish, but one can't make a sardine out of a salmon.

The young of either of the species of Clupea would make real sardines, or at least the nearest thing to them possible on this coast. The sardines of commerce are the young of the pilchard, *C. pilchardus*. These three species are the only true herrings found on this coast, but the related and world-wide species, *Albula vulpes*, the lady fish, is tolerably common farther south, and occasionally puts in an appearance in our markets among the fish from Monterey.

The anchovy can be readily known by its comparatively very large mouth, the under jaw of which is much shorter than the upper; but the two Clupeæ, though seen to be quite different when placed side by side, are not so easy to distinguish without examination. I will give a few of the principal distinguishing characters:

Clupea sagax.—Body thick, elongate, depth to length as one to six; thickness two-thirds of depth; head slightly more than one-filth of total length; lower jaw scarcely projecting; no teeth in mouth, no denticulations on lower margin of maxillary; operculum striated; anterior margin of dorsal nearer the tip of the snout than to the origin of the caudal; area included between the ridges on the top of the head narrow, pointed posteriorly; a row of dark spots on each flank.

C. mirabilis.—Body short, compressed, depth to length more than 1.5, thickness about two-fifths of depth; head not more than one-fifth of total length; lower jaw considerably projecting; a few small teeth in mouth, lower edge of maxillæ denticulated; operculum smooth; anterior margin of dorsal fin slightly nearer to the origin of the caudal than to the tip of the upper jaw; area included between the ridges on the top of the head an elongated ellipse; no spots along the sides.

—*W. N. Lockington.*

Recent Articles on Crustacea.—About a year and a half ago a request was sent to the various museums of the world by Drs. Schiödte and Meinert, of Copenhagen, requesting the loan of all specimens of Cymothoidæ, for the purpose of monographing the group, and the first portions of the monograph have just ap-

peared.[1] From it we learn that only two American museums contributed, the Peabody Academy of Science at Salem, Massachusetts, and the Museum of Comparative Zoölogy, at Cambridge. The first of these papers treats of the Cirolanidæ, which closely resemble the true Cymothoas, but which differ in having the mouth parts adapted for eating flesh. Three genera and nine species are characterized, of which the genera Barybrotes and Tachæa, and the species *B. indus*, *B. agilis*, *T. crassipes*, *Corrallana collaris*, *brevipes*, *nodosa* and *hirsuta* are new. Each species is described as far as the specimens permitted, under three heads—male, virgin, and ovigerous females—the difference between the sexes and between the two forms of the same sex being very striking. In the second paper the Ægidæ are monographed. These Crustacea lead a parasitic life, generally attaching themselves to the roof of the mouth of fishes, and with their modified mouth parts, which form a sucking tube, living on the blood of their hosts. These forms are described under the following generic and specific names, those starred (*) being new: *Æga tridens*, *hirsuta**, *crenulata*, *webbii*, *strœmii*, *rosacea*, *serripes*, *psora*, *deshayesiana*, *antillensis**, *magnifica*, *monophthalma*, *nodosa**, *opthalmica*, *tenuipes**, *dentata**, *incisa**, *arctica*, *ventrosa* and *spongiophila*, *Rocinela danmonensis*, *insularis**, *dumerilii*, *maculata**, *americana**, *orientalis**, *australis**, *signata** and *aries**, *Alitropus typus* and *foveolatus**. Full descriptions are given of the male, virgin, ovigerous female and the young. The plates are engraved by Lövendal, the best living scientific engraver, and are simply beautiful; the text is in Latin, which is far better for the man of average education than would be the native language of the authors, and in short, the articles are models of scientific work.

Mr. Edward J. Miers has at various times since 1874 published several valuable papers on the Crustacea, some of which have been noticed in the pages of the NATURALIST. A number of these papers have been especially valuable from the fact that they embraced all the known species of certain families and genera. His twenty-third paper has just been received, and is of the same character as his "Revision of the Plagusiinæ," "Notes on the Peneidæ," "Revision of the Hippidea" and "On the Classification of the Maioid Crustacea." In the present paper[2] the Mantis shrimps are monographed, fifty-three species being enumerated, distributed in six genera. There is one feature of Mr. Miers's work, which is to be especially commended; in these days of much species making, his tendency is just the reverse, and we

[1] De Cirolanis Ægas simulantibus commentati brevis scripserunt. J. C. Schiödte et Fr. Meinert. Naturhistorisk Tidsskrift III, XII, pp. 279–302, Pls. III–V (1879.)

Symbolæ ad monographium Cymothoarum Crustaceorum Isopodum Familiæ scripserunt J. C. Schiödte et Fr. Meinert.

I Ægidæ. l. c. pp. 321–414 Pls. VII–XIII (1879). From the authors.

[2] On the Squillidæ. Annals and Magazine of Natural History for January and February, 1880, pp. 49, Pls. I–III.

think generally that he is right. As an instance of his onomaclastic spirit (to coin a word), the fifty-three species of Squillidæ have been described under seventy-six different specific names. The new species described are *Lysiosquilla brazieri, gonodactylus, excavatus* and *9-furcicaudatus*. A new genus *Septosquilla* is created for *Squilla schmeltzii* A. M.-Edw. and *Chloridella* is substituted for *Chlorida*, preoccupied. The plates are fair.—*J. S. Kingsley.*

ANOTHER BLACK ROBIN.—In the Bulletin of the Nuttall Ornithological Club for January I described a case of melanism in *Turdus migratorius*, the specimen being taken from a nest at Freehold, New Jersey, last summer. I have lighted on another specimen taken from a nest the same season, in Hudson county, New Jersey. In this instance the color is more intensely black, and the neck has considerable of that play of metallic luster, of a purple hue in the varying light, which we see in the crow-blackbird, *Quiscalus purpureus*. The Freehold specimen is of a sooty-hue, not unlike the color of the rusty grackle, *Scolecophagus ferrugineus*. The Hudson county specimen was owned by a saloon keeper near Jersey City, who set a fancy price on his bird, and failing to find a purchaser, at last accounts, was trying to raffle off his *rara avis* at two dollars a chance.—*S. Lockwood, Freehold, New Jersey.*

OCCURRENCE OF THE BOHEMIAN WAX-WING IN WESTERN WASHINGTON TERRITORY.—The past winter has been an unprecedented one, snow having fallen to the depth of from two to three feet in the valleys—the lowest observed temperature was + 8°, which, however, was not as cold as before known. Coincident with the snow, appeared for the *first time in the history of the country*, the Bohemian wax-wing *(Ampelis garrulus)*.

Many flocks of these beautiful birds were seen in various parts of the country, the greatest number observed in one flock was about two hundred. They were feeding mostly on the capsules of the wild rose *(Rosa fraxinifolia)*, which are abundant here, the crops of some I dissected were literally crammed with these seed vessels.

Since the first of February none have been seen, hence I conclude that, with the disappearance of the snow, they have retired to colder regions.—*J. K. Lum, Lewis county, Washington Territory.*

ROSE-BREASTED GROSBEAK AND COLORADO POTATO BEETLE.—Regarding this useful and pleasing bird, the following appeared in the *New York Weekly Tribune*, of February 11, 1880, to wit: "Prof. C. E. Bessey, of the Iowa Agricultural College, several years ago observed the rose-breasted grosbeak's habit of feeding on the Colorado potato beetle * * *. Its useful propensity was again remarked during the past year by a correspondent of

Forest and Stream at Coralville, Iowa, and by another at Ames in the same State." In a small aviary which I keep for better observing the habits of our native and several foreign song birds, the same preference in the selection of food was noticed by myself. September 18, 1879, I found in the flower bed of my yard, a potato beetle *(Doryphora decem lineata)*, which I intended to give to my cardinal grosbeak *(Cardinalis virginianus)*. After placing it in the cage, it was with difficulty that I prevented the rose-breasted grosbeak *(Hydemeles ludoviciana)* from seizing it at once. Knowing the potato beetle to be poisonous, at least to the genus *Homo*, I did not care to try experiments with the tame rose-breasted grosbeak, my sweetest songster in the aviary. I had often before noticed, that the cardinal grosbeak had a fondness for beetles, and naturally supposed that he was better qualified to judge of the wholesomeness of the food offered.

The latter bird watched the beetle very attentively as it crept over the floor, but seemed to be in no hurry to capture it as he would other beetles. Finally he took hold of and crushed it between his mandibles. He tried to swallow it, but not finding the taste very appetizing, he gladly yielded up the unsavory morsel to the repeated snatchings of the rose-breasted grosbeak. After crushing it into a shapeless mass, which occupied but a few seconds, he carefully stowed it away. I thought he seemed not to enjoy the taste very much, as he gravely shook his handsome head as if in a doubtful mood. Wiping off his bill, he immediately afterwards proceeded to eat a quantity of cultivated portulaca that I offered as a precautionary measure. Portulaca stems and leaves contain much mucilage, which I thought would be an antidote to the possible acrid quality of the juice of *Doryphora decem-lineata*. The usual result of poisoning from handling these crushed beetles, as well as from inhaling the fumes arising from vessels in which *D. decem-lineata* have been scalded, has been likened to serpent and scorpion-poisoning. Where death followed, the blood would become disorganized the same as from septæmia. However, in the case of the birds no evil effects were noticed. In mankind, idiosyncrasy favors the absorption of the volatile doryphora poison.

In looking over my notes, I find also that the cardinal grosbeak is fond of the rose beetle *(Macrodactylus subspinosus)*, a species of an ill-smelling bug frequently found on the fruit of raspberries, and centipedes he always devoured, whereas none of the others would go near them. Sow bugs *(Oniscus asellus* L.) were eaten by the cardinal grosbeak and yellow-breasted chat *(Icteria virens)*.—*Richard E. Kunze, New York.*

Can Snails Mend their Shells.—Having some doubts whether snails are able to mend their shells when broken, I procured a full grown water snail *(Lymnæa elodes* Say), and with a pair of pinchers broke out a semi-circular piece, the size of a half dime, and then

placed it in a tub of water containing aquatic plants. Everything being in order, I took notes of changes as they occurred. At the end of three days no change had taken place in the size of the aperture, but the sharp edges where the shell was broken, was somewhat rounded, showing plainly that the work of repair was going on. At the end of six days the opening was perceptibly smaller. At the end of two weeks so much progress had been made that the opening was one-third closed, and the line where the patching commenced, although very smooth, could be distinctly seen. I continued to watch my pet from day to day with more and more interest, until finally at the end of six weeks the work was completed, and to all appearances as smooth as it was before it was broken. It was very interesting to watch its movements, it would make a circuit around the side of the tub, and then push off toward the middle, where the food plant was anchored, and feed awhile, and then return and make another circuit. Occasionally it would disappear for some time to tend to duties below, probably to lay eggs, as I found them very numerous on the side of the tub, and in the fall when the tub was emptied, scores of young snails were found sticking to the sides.—*Robert Bunker.*

VICTIMIZING RATTLESNAKES.—A short time since a gentleman related to me a novel way of depriving the rattlesnake of its poisonous powers. In parts of the West where this species (*Crotalus confluentus*) is more common, and most annoying, a person attaches a silk handkerchief to a stick, and holds it over the reptile. The instant it darts its fangs into the silk, the handkerchief is jerked up, and the fangs removed. After this the snake is of course powerless, and may be used in any desirable way. I have never seen the experiment put in effect, and give it for what it is worth.—*W. H. Ballou.*

BYTHINIA TENTACULATA LINN.—In June, 1879, I discovered *Bythinia tentaculata* Linn., at Oswego, New York. A little later it was identified in the Champlain canal, at Waterford and Troy, and this spring I have found it plentiful in the Erie canal, at Syracuse, New York. In some localities it is already abundant, and will soon be a widely distributed shell. It must have been introduced from Europe some time since, but had hitherto escaped notice.—*W. M. Beauchamp.*

COLOR VARIETY OF THE CHIPMUNK.—A curious color variety of *Sciurus hudsonius* Pallas, was brought to us not long ago, and has seemed worthy of a brief notice. That it is a variety of *S. hudsonius* is unquestionable. In general color it is less brown than any specimens in our collection. A band of rather dull reddish-brown runs along the median line of the back from the top of the head, just behind the eyes, to the base of the tail. This tinge dies out as it proceeds toward the lateral parts of the body, and

is utterly wanting on the legs. The white color of the under side of the body is distributed as is usual in this species

The tail is narrow and not at all bushy, and reaches about to the neck of the specimen; it is white with a very few reddish hairs on the upper surface of the part nearest the body. A very few black hairs may also be seen very sparingly scattered throughout.

Two specimens of this variety were observed in the trees of Middletown, and one of these, captured in a trap set for rats, is the individual now before me.—*H. L. Osborn.*

Ferocious Tendencies of the Muskrat.—It is possible that others have commented on the unnatural and ludicrous attacks of the muskrat (*Fiber zibethicus*) on man. However that may be, I have some incidents in point which may serve to throw light on the matter.

I was sauntering along a prairie road just out of Boone, Ia., one night during the past winter. There was no snow on the ground and the moon was just glimmering through the clouds. Of a sudden I was startled by the appearance of some animal from the long grass by the wayside, which dashed up my leg. I knocked it off, picked up a frozen piece of mud and broke its leg. Again it made a rush for me, and another piece of mud sent it rolling over. I took hold of its tail during this little scene, and ended the matter by giving its head a severe bump on the ground. When I had access to more light I found that it was a full-grown muskrat of enormous size. I can neither account for its attack nor appearance there. The previous summer season had dried up all the sloughs and there was no water in the vicinity. The houses of these animals had been deserted for some time previous, and nowhere on the prairies had I been able to find one with any inhabitants (they build in the sloughs of western prairies extensively). Alone and well away from its most natural element it had attacked me without provocation. The matter led to an inquiry among the farmers. The general statement was to the effect that considerable fun and some trouble was had with this species during each hay time, as they did not hesitate, when out of the water, to ferociously attack man or beast, with seldom any damage. One man related, however, that he received a severe bite in the hand from one of them, which laid him up for some time. It is either very courageous or very luny.—*W. H. Ballou.*

Nesting English Sparrows.—During the entire month of February, the English sparrows (*Passer domesticus*) have been busily engaged in Chicago, preparing their nests. Long before the arrival of other park birds, they have selected all the nesting boxes and hundreds of nests are completed This is my first observation of this game being played, and I believe that it is an advantage they have taken of migrants to secure nesting places

without trouble. They may be seen any day picking straws out of the street. What our summer birds will do, or whether they will remain here or not, remains to be seen. In reference to the spread of these birds in the Western States, I have this observation: In central Iowa, are two cities, Boone, and Boonesboro, situated a mile apart. The intervening space is well trodden with roadways. During the past winter I have noticed literal thousands of sparrows on the snowless ground here, picking the seeds and scratching over the manure. They have carefully treasured up the trick of the small boy, and any attempt to pick up a stone, results in their immediate departure. So pestiferous have they become, that the State legislature of Iowa has their extermination under consideration. They use the great lines of railways for guidance West, and last spring while on my way to New York, they were seen migrating in flocks westward, all the way from Chicago to that city. In an Eastern city, I noted that one side of a beautiful brownstone church was covered to a remarkable extent with their filth. In spite of their rapid increase and filthy habits, however, I am disposed to believe that they are of *some* use.—*W. H. Ballou.*

Bird Arrivals at Evanston, Ill.—The arrivals of robins at Evanston, Ill., on the 12th day of February, is something unheard of in the annals of the ornithological records of this section of the country. The following is a portion of the records of *Turdus migratorius* in previous years:

1877	arrived	February 27.
1878	"	March 8.
1879	"	March 12.
1880	"	February 12.

The thermometer has indicated quite a high temperature for the latitude of Evanston, about 41° 52′ 57″, north, 42m. 18s. west longitude from Washington, and 5h. 50m. 30s. (from Greenwich), for the entire month of February, and up to the 25th, the mercury has not reached zero. On this account perhaps, the birds have remained contentedly, and their chipper is occasionally heard. About twenty specimens have been seen here. The migrations are limited up to this writing to this one species. They have not yet begun nesting in this vicinity.—*W. H. Ballou.*

Gadus morrhua in Fresh Water.[1]—The catalogue below quoted includes strictly fresh-water fishes only, and such marine fishes as are frequently found in fresh water. I have, however, been somewhat perplexed by a couple of species, which are stated by C. E. Varming, a merchant in Kolding, to be caught now and then in Kolding rivulet, namely Torsk *(Gadus morrhua)*, which in September and October is caught in abundance, and Tangsnarr *(Spin-*

[1] Fortegnels over de Danske Ferskvandsfiske. Ved Arthur Feddersen. Naturhistorisk Tidsskrift 3. R. 12. B. 1-2. H. 1879. Foot note on pages 69 and 70.

aclna vulgaris). Indeed, in the rivulet mentioned my countryman has even himself caught or seen caught the common Kulmule (*Merluccius vulgaris*) and Pighaien (*Acanthias vulgaris*) which are not found elsewhere on the coast. The Torsk is said of late years to go quite up to the basin at Odense; in the rivulet, however it ascends scarcely beyond Korup. —*Translated by Dr. Bean, and received from Prof Baird, Secretary of the Smithsonian Institution.*

Rev. Mr. Dallinger on the Theory of Spontaneous Generation.—In a valuable paper in the Journal of the Royal Microscopical Society for February, the author records the results of a series of experiments made to determine the thermal death point of known monad germs, when the heat is endured in a fluid. He made it plain, that a temperature of 140° to 142° Fahr is absolutely destructive of the adult monad. The spores of six monads in the case of heat endured in a fluid were killed at the following temperatures: the first were destroyed at from 267° to 268° Fahr; a second form had its spores devitalized at 212° Fahr, *the normal boiling point of water;* but in a dry heat, it could endure 250° Fahr; a third died at 250° Fahr. in dry and 232° Fahr. in fluid heat; the spores of a fourth form (a cerco-monad), were destroyed at 238° Fahr in fluid heat, surviving at 260° Fahr. dry heat. There were two species that could just survive 300° Fahr. in the dry heat, but perished in fluid at 208° Fahr and 252° Fahr., respectively. The smallest spores survived the heat best.

Mr. Dallinger thus concludes: "The bearing of these results on the deeper questions of biology is plain; at least they show on the most superficial glance, the error of assuming the abiogenetic origin of septic organisms that may have arisen in closed vessels, *because* they were heated to a sufficient temperature to destroy the adult, or to any temperature less than that *known* to be destructive of the germ. They show equally the need of enlarged and earnest work in this somewhat difficult but most fruitful field of labor. The question of the *present* origin of living things, or living matter in any form, will be most surely narrowed by degrees, and settled, so far at least as our present optical aids can carry us here. The question of 'spontaneous generation' *versus* abiogenesis, is in its final form, a question for the biologist, or rather for biology. It can avail little in the quest for truth, in this matter, to assume the issue, and work up to it; nothing is easier than this in such an inquiry. With modern students of biology, I suspect that at the beginning, the bias of the mind was towards the present or continued transition of the non-living, into the living, without the intervention of living things. This on a superficial view at least, seemed to be required by the doctrine of evolution, and at least represented my own view in approaching the question. But the *facts* were eloquent; besides which a closer study of the great

doctrine of development, shows that it by no means involves, but rather disallows, the existence of continued transformation of the not-living into the living, unless passed through, so to speak, the alembic of life. To suppose any hesitancy on the part of any truly scientific mind in receiving the evidences of abiogenesis if they could be satisfactorily shown, is too ridiculous for repetition. It would be more than weakness, however, to receive as evidence what is not such. Let *truth* come from whence it may, and point never so grimly to where it may, he would be recreant to science, who would for one moment hesitate to receive it. But not less false is it to the foundation principles of true science, to accept as true, what must constitute the roots of vast generalizations, except on evidence which no future scrutiny or analysis can shake."

THEORY OF BIRD MIGRATIONS.—I am not aware of the applicability of the following to all parts of the country, but am convinced that I have the facts in regard to the migrations of birds in Illinois. For four seasons I have carefully noted the bird arrivals in Illinois, the results of which have been published in the Chicago *Tribune* as annual reports.

In each instance noted, the first four species to arrive and which all arrived together, were the robin, meadow lark, grosfinch and bluebird. In each instance these species came with a terrific gale of hot wind from the south, which lasted some two or three days and nights. The thermometer on each occasion stood at 70° F. Now to my mind the time of migration is set by the continuance of this excessive heat and current of air.

I have two proofs of this. In 1878 there was an open winter and they did not arrive until late in the spring, though the thermometer stood generally at 30° and 40° each day. It was not until the several days of hot air with a thermometer at some 70° that they arrived.

Again, this season a hot air current came, lasting one day and part of a night, with the mercury at 70°, only a few robins came, and the migrations were not general even with this species; the other three species wisely staid away, waiting for the usual three days of hot air. I am confirmed in this opinion in the fact that in the spring of 1879 I wrote out my account of the bird arrivals for this region (Evanston, Ill.), and five days later visited Northern New York; there was four feet of snow at Oswego, and of course not a summer bird had made an appearance. It was about the first of April when the three days' current of hot air reached Oswego county, and then the birds arrived.

Migrations, then, depend, as to time, on a continuous current of hot air and high temperature, extending at least through sixty hours.

As to the route of the migrations, I coincide with the opinion

expressed at least by Theodore Jasper in his "Birds of North America," that they follow mountain ridges and water courses.—*Wm. Hosea Ballou.*

ALBINO BEAVER AND SQUIRREL.—During the past winter a white beaver *(Castor fiber)* was caught near Olympia, Washington Ter. The specimen was a large one, and remarkable for the purity of its color; the hairless tail, as well as the whole body being entirely white. The specimen here mentioned was preserved and may be seen in Olympia.

While traveling in Douglass county, Oregon, I came across a white squirrel *(Sciurus fossor).* This squirrel is abundant in the neighborhood, and is remarkable for the constancy of its coloration, this being, I believe, the first recorded instance of an albino of the species. The coloration was white with a slight buffy tinge.—*J. K. Lum.*

SOME HABITS OF THE PINE SNAKE.—The note in January NATURALIST on the vibration of the tail in certain species of snakes, leads me to ask if this habit is not more general than has been supposed. The pine snake, *Pituophis melanoleucus*, is naturally sluggish, yet I have seen it when excited so vibrate the tip of the tail that it looked like a little fan, though I never detected any sound. Twice have I had the pine snake lay eggs in my study, the largest number being twelve, but they were as large as pigeon's eggs. For many years have I been on the lookout to find the egg nidus of this serpent, and only succeeded in the early summer of 1878. This was in an open sandy spot in the pines near here, about three inches below the surface. The deposit contained forty one eggs, but very much smaller than those laid in confinement. I had them all brought to my house, and made a vain effort to hatch them. At last I broke open a few, and found each to contain a young snake about five and a-half inches in length. The number of eggs and the size of the young snakes severally compared with the size of the egg much surprised me.—*S. Lockwood, Freehold, N. J.*

NOTES ON THE FISH-HAWKS.—In the "Naturalist's Guide" (1877), Part XI, "Catalogue of the Birds of Eastern Massachusetts," by C. J. Maynard, on page 134, is the following note, viz.: "*Pandion carolinensis* Bon., fish-hawk. Not a common summer resident, growing less so every year. Perhaps a few breed in the interior, but it is doubtful." Mr. Maynard also placed the bird in his list of "regular spring and autumn migrants," *vide* page 165.

I was much surprised when I read this note, as no bird is more familiar in this locality than the fish-hawk. It is with us a regular summer resident, arriving early in the month of March, and departing late in November, and breeds every season quite abundantly. From more than a quarter of a century's personal obser-

vation, I can attest that these hawks have not perceptibly diminished in numbers in this vicinity, and I can find a dozen or more nests of this species, each within an hour's drive of my home, which have been occupied by them every season for years, and in which they have annually reared their young. For nearly nine months of the year I can look up any day and almost any time of day and see one or more fish-hawks watching for prey, or going to and from the nest. Some of the nests are located near the banks of Taunton Great river, or on the shores of Mount Hope and Narragansett bays, and some are situated a mile or more from the water. Perhaps I live in a paradise for fish-hawks, but I should not have been more surprised to have read that the robin, blue-bird and song sparrow were uncommon summer residents, and that but few of them bred in this region. Though not so numerous as swallows or blackbirds, if the phrase "common summer resident" is applicable to any representative of our avifauna, it is applicable to *Pandion haliætus.* The osprey begins to build a new, or much more commonly, to repair an old nest soon after their arrival. From two to four eggs are the usual complement, and incubation commences in May. While the female is setting, the male brings her food, and at times takes charge of the eggs as the mate goes off for an airing. One of the pair is on or in sight of the nest from the time incubation begins until the young are able to shift for themselves. I have repeatedly seen the female on the nest, and her mate perched on a limb of the tree preening his feathers or murmuring a not unmusical strain, evidently as a solace to his companion, while robins, blackbirds and sparrows lit upon the branches and sang their melodious refrains apparently unnoticed by the hawks.

Harmless to the agriculturist, protected by the fisherman, watched with intense interest by all who care for our birds, second to none in the matchless majesty of his mien, the fish-hawk is seldom molested save by the oölogist and ornithologist, or the mere collector of eggs.—*Elisha Slade, Somerset, Massachusetts.*

POLYMORPHOUS ANODONTÆ.—Nearly all collectors of shells are familiar with the extensive synonomy of the European *Anodonta cygnea.* Dr. Lea, in his Synopsis of the Unionidæ, reduces to its synonomy more than one hundred specific names. It would seem that, in their descriptions of shells, the Old World naturalists have given specimen characteristics rather than more or less permanent species diagnoses. This unfortunate polymorphous shell has thus afforded abundant material to the mere species monger, and has no doubt been a "thorn in the flesh" to youthful collectors. This European shell, however, finds a rival, though on a much less extensive scale, among its American relatives. For

some years the writer has been receiving specimens of a polymorphous *Anodonta*, ranging geographically from New York to Western Iowa, including the important streams throughout this entire range. These shells have been received under the various specific names of *Anodonta grandis* Say; *A. plana* Lea, *A. decora* Lea; *A. hockingensis* Moores, MSS.; and *A. somersii* Moores, MSS. A very careful diagnosis of the exo-skeleton of all, and the soft parts of some of these, has convinced me of their specific identity. The following observations are based, in part, upon correspondence from various gentlemen who have kindly forwarded me specimens for examination.

In Keokuk lake, about five miles from the city of Muscatine, Iowa, *Anodonta grandis* is found in great abundance. The shells vary in shape from a short full round form to a long and flat form; some are quite thick, others remarkably fragile for their size. For some unexplainable reason, as Prof Witter writes, the young of *grandis* are rarely taken in this lake. Now, this remarkable diversity of form in this single locality is a fair representation of the increasingly proximate gradation in these above-mentioned species from New York to Western Iowa The form known as *decora* Lea, from New York could not be distinguished readily from the *grandis* at Muscatine. The shells from that State are less heavy than from any other section represented in my cabinet. The Eastern forms are more compressed as to the beaks, rather more inflated, and having the posterior dorsal slope rather more oblique. From Ohio were received forms with much thicker shells, and white prismatic nacre. Both *decora* and *plana* from that State has a much more brilliantly colored epidermis than any of the more Western forms. In this respect they sustain to *grandis* essentially the same relation that the brilliantly colored *Unio siliquoideus*, sustains to *U. luteolus* Laur., of which it is only a variety. In Indiana, Illinois, and Iowa, the most marked difference appear to be in the coloration of the nacre, which varies from white to a very deep salmon, the latter being the most constant color in the Western limit. The two species described by Mr Moores, mentioned above as manuscript descriptions, are, beyond doubt, the young of *grandis*. Carefully comparing all my specimens, some sixty in all, with typical *grandis*, the conclusion reached was that these forms are all varieties of Mr Say's shell, which was further strengthened by the fact, that being arranged geographically, from the East to the Mississippi, the former gradually approach the shell described by Mr Say in 1829. Their differences correspond in general with the modifications of the mantle, some of them being sexual, but the major part may be explained on the basis of distribution and the changes in environment which this implies.—*R. Ellsworth Call, School of Science, Dexter, Iowa.*

PRELIMINARY NOTE ON BRANCHIPOD CRUSTACEANS.—In an isolated small pool, with a white clay bottom, containing milky colored fresh water near Maspeth, Long Island, I found in January last immense numbers of a full-grown, transparent species of Branchipod, which transparency as well as some morphological differences I adjudge to be owing to the fact that Branchipods and many Entomostraca, so much depend on their physical surrounding, as pointed out by Prof. A. S. Packard, Jr., in his paper, "Synopsis of the Fresh-water Phyllopod Crustacea." Pale or transparent "races" of Branchipods have repeatedly been recorded in zoölogical journals. The morphological differences. together with a hermaphrodite, a Chirocephalus and gradual transitory stages between this pale race and *Enbranchipus vernali* Verrill, I shall soon endeavor to bring to notice.—*Carl F. Gisslers.*

[See Schmankewitch's paper on the influence of external circumstances on the organization of animals. Zeits. Wissen. Zoologie. XXIX, 1877.—*Editors.*]

A NEW SYNTHETIC TYPE.—At a recent meeting of the Zoölogical section of the Russian Association of Naturalists, Kovalevsky gave an account of *Cœloplana metschnikowii*, a new form from the Red sea, intermediate between the Cœlenterates and the Planarian worms. In its outer form it resembles the Planarians; is gray above, white below, and about three lines in length by two in breadth. The mouth is a slit-like opening in the middle of the ventral surface, and communicates with a four-lobed stomach which resembles most nearly the "funnel" of the Ctenophora; from it originate a large number of canals which radiate to the periphery of the animal and open into a ring canal which bears many cæcal appendages. On the dorsal surface, almost directly over the mouth, is a vesicle containing a number of vibratile otoliths. On either side of this otocyst is a sheath from which can be protruded a long retractile tentacle. Each tentacle is branched and corresponds in shape to those of *Cydippe* and *Eschscholtzia*, only they have no central canal but are composed of muscles. The nervous system and genitalia were not observed. The body is covered above with vibratile cilia.—*J. S. K.*, *abs. Zool. Anzeiger*, III, p. 140, 1880.

ZOOLOGICAL NOTES.—According to Mr. R. B. Roosevelt, the fish hatching commission have raised hybrids between the following fishes: Salmon trout with white fish; salmon trout with brook trout; brook trout with fresh water herring, with California salmon, and with the California mountain trout; shad with striped bass and with herring. Of these crosses there are the young, now in the hatching-house, of the salmon trout brook trout, brook trout California salmon, and brook trout California brook trout. It is observable of all hybrids that they are usually more shy and wild than either of their parents, and that in appear-

ance they generally fivor their larger parent. The cross between the brook trout and California salmon and the salmon trout and brook trout bid fair to be fine fish. Those now in the hatchery are eight inches long. It is to be hoped that further careful experiments may be made to ascertain whether these hybrids are fertile, and can produce fertile offspring. Apropos of fertile hybrids certain journals have stated that a mule in Paris has had six young, from a horse, ass and a zebra.——Mr C. C. Lobingier, of Allegheny county, Pennsylvania, states in the *American Agriculturist*, for May, that the copperhead snake swallows its young; that he took out thirty four young from three and a half to six inches long from four old ones. In the April number of the same paper it is claimed that rattlesnakes swallow their young. Compare the NATURALIST for May, 1868 (vol. II, p. 133).——The report on the Florida Reefs, by Louis Agassiz, is reprinted in the Memoirs of the Museum of Comparative Zoology, vol VII, with the addition of twenty-one beautiful plates, illustrative of the reef-building corals, and an additional plate of the coralline plants. ——Dr. Harrison Allen figures and describes a fœtal walrus in the Proceedings of the Academy of Natural Sciences of Philadelphia ——Dr. Evarts describes in the *American Monthly Microscopical Journal* a new species of Ophrydium *(O adæ)*, and Prof. D. S. Kellicott gives an account of a new Argulus *(A. stizostethu)*. ——New Diptera are described by Mr. S. W. Williston, in the Transactions of the Connecticut Academy ——An Englishman's notions about the English sparrow are given in Mr. R McLachlan's address to the members of the West Kent Natural History, Microscopical and Photographic Society; he concludes: "If the advantages of living in a free country have not so far intensified, in America, the ultra-radical proclivities of our sparrow, as to have eliminated from his nature those certainly good qualities he possesses here, I venture to predict our generous kinsmen on the other side of the Atlantic will end by tolerating him, and, probably, by an inward conviction that the *absence* of our sparrow would leave with them, as with us, a blank impossible to fill up"——The marine invertebrates of Vancouver and the Queen Charlotte's islands, coast of British Columbia, have been investigated by Mr. G M. Dawson, and the species enumerated by Mr. J F. Whiteaves, with descriptions of new forms by Profs. Verrill and Smith ——As a further contribution to the subject of insect-destroying fungi may be cited a short article in the *Comptes rendus*, by MM. Brongniart and Cornu on an epidemic among Syrphus flies caused by a fungus (Entomophthora)——A new illustrated work on the Pediculi, by E. Piaget, to form two quarto volumes, is announced to be published at Leyden, by E. J. Brill, who desires subscriptions.

ANTHROPOLOGY.[1]

SYPHILIS.—In deciding the much ventilated question concerning the supposed introduction of syphilis from America into the Eastern hemisphere by the earliest Spanish explorers of the West Indies, the passage printed below may not be unimportant. It is an extract from the Caraïb-French Dictionary of Raymond Breton, page 478–479 (under the term *yaya*), and although this dictionary was published one hundred and sixty years after Columbus' discovery, it nevertheless gives a graphic account of the disease, which was then indigenous among the savages of the Island of Guadalupe, and had certainly been in existence there long before. According to the authors of the seventeenth century, syphilis was very common among some other Indian nations of southern lands. I have substituted the modern French orthography for the ancient one of the Rev. Father Breton:

Yaya: pians; *yayari hoïièe:* vérolé. C'est une maladie naturelle que l'on tient communément aux Iles, comme la grosse vérolé en France, et dont les sauvages se guérissent sans peine et sans danger, non seulement à cause de la température de l'air qui est fort égale, mais aussi a cause des puissants remèdes qui naissent sous la zone torride, et qui n'ont rien perdu de leurs facultés récentes comme ceux que l'on apporte ici de ces îles par un trajet de 1800 lieues. Ils ont le jus de l'écorce de *Chipiou* (a tree, the sap of which is exceedingly bitter), dont ils se pottent au dehors, se noircissent du jùs de Genipa et des feuilles de roseaux brûlées; ils prennent le jùs de quelques liennes (for: *lianes*) comme de l'écorce du *mibi* (a creeping plant) avec de la râpure de cul de Lambis. Quand les grosses pustules crevent, ils appliquent des plumaceaux de coton cru qui resserent les lèvres des ulcères et en empêchent la déformité. Mais autant que cette grosse vérole est peu dangereuse chez eux, quoique fort commune et que tous les remédes ci-dessus opèrent sans étuves ni vif-argent, d'autant plus la petite vérole qui est très-rare parmi-eux leur est périlleuse et comme une sorte de peste parmi nous.—*A. S. Gatschet.*

FOOTPRINTS OF VANISHED RACES.—The foregoing is the title of a work by Mr. A. J. Conant, of St. Louis, Missouri, and published by Chancy R. Barns, of the same city. As it was intended to be a popular treatise, the introductory chapter to a voluminous work entitled, "The Commonwealth of Missouri," our estimate of the volume should keep that fact in view. The writer wields a glowing pen, and in his zeal to honor "the traditions of the elders," frequently steps beyond the limits of sober truth. This remark, however, applies only to the "padding" inserted for the general reader, and not to the very valuable descriptions of the Big Mound at Saint Louis, the works in the south-western corner of the State, and those in the Ozark mountains. Mr. Conant

[1]Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

is the first to bring out prominently the existence and construction of barrows, or chambered mounds, in Missouri. The Big Mound, referred to above, contained a chambered tomb whose dimensions were from eight to twelve feet wide, seventy feet long and from eight to ten feet in height. This structure formerly stood at the corner of Mound street and Broadway, in St. Louis, and was entirely removed in 1869. It was one hundred and thirty feet long and thirty feet high. Its demolition drew crowds of spectators to the spot during the many weeks occupied in its removal. Mr. Conant made personal and careful examinations of the work during the whole process of destruction. His enthusiasm may be inferred from the following paragraph: "Being desirous of procuring a perfect skull, I began a careful excavation with a common kitchen knife near the feet of a skeleton, following the spinal column to the head. My work, however, was soon interrupted by the crowd of eager boys from the neighboring schools, who scrambled for the beads thrown out with each handful of earth, with such energy, that I was lifted from my feet and borne away. By the aid of a policeman I was able to finish my excavation, but without having the fortune to secure what was so much desired." Mr. Conant has devoted the leisure of fifteen years to archæology, and upon those subjects with which he is familiar, is a valued contributor to the increase of knowledge.

Spencer's Ceremonial Institutions.—Messrs. D. Appleton & Co. have just issued a volume by Mr. Herbert Spencer, entitled, Ceremonial Institutions; being Part IV of the Principles of Sociology. It is also called Vol. II of the Principles of Sociology, the first volume, yet unfinished, including Part I. The Data of Sociology; Part II. The Inductions of Sociology; and Part III. The Domestic Relations. A portion of this volume is familiar to students through the *Fortnightly Review*; but five chapters are entirely new. In their present form, the twelve chapters treat consecutively of Ceremony in general, Trophies, Mutilations, Presents, Visits, Obeisances, Forms of Address, Titles, Badges and Costumes, Further Class Distinctions, Fashion, Ceremonial Retrospect and Prospect.

Instead of marring his pages with an excess of foot-notes, the author has adopted the fashion of our best modern classical text-books, in which the notes follow the text, and are referred to by paragraphs. A list of the titles of works consulted comes after the chapter of notes. Perhaps no living writer has done so much systematic reading as Mr. Spencer, and yet we miss from the list of authors a few names of those who, like Mr. Morgan, have done most to make us acquainted with the true inwardness of savage life. The task which the author sets before himself is to prove that ceremonial government is the earliest, the most generally diffused, and most constantly active form of control. At the same time, the idea of spontaneity is kept before the mind in opposition

to conscious choice and control. Those who are familiar with the history of discussion concerning the origin of human institutions are aware that the road pursued, the *modus operandi*, the order of sequence, can be sharply distinguished from the part played by human intelligence and choice in their evolution, or elaboration. Mr. Spencer gives the maximum weight to extraneous influences or spontaneity, allowing conscious selection to have had only a small share in the operation. Some of the author's attempts to trace mysterious customs to a natural genesis are extremely ingenious; as, kissing to smelling and licking of young (p. 15–17); the carrying of boughs or branches of trees to show that no arms are secreted (p. 22–25); all State and religious ceremonies and observances to affection for, and subjection to, the living or the dead chief; the hoarding of heads, jaws, fingers, foreskins, scalps, and other portions of an enemy's body as demonstrating prowess and witnessing to superiority; mutilations of all kinds are an advance upon taking trophies from dead enemies, since the cônquered is held as a slave or vassal; present making is referred to propitiation of chiefs or gods, as an acknowledgment of submission, and from these develop tribute, taxes, fees, salaries, oblations, and church revenues; visiting is traced to the necessity of appearing statedly at court as an evidence of loyalty, and church-going and pilgrimages of all kind, to reverence for the ghost or the god; obeisances are putting the body in a position which shows that we have given ourselves up to be killed; badges are derived from trophies, and even clothing is a development of the badge rather than a prompting to protection or decency; and fashion is propitiation by the imitation of defects and shortcomings.

The decay of ceremony as we pass from militancy to industrialism is insisted on throughout the volume, and at its close. The vast amount of research in the preparation of this work, makes it a storehouse of information, even to those who may think with Mr. Tylor, that "pleasant bodily sensations" and many other motives than fear may have coöperated in ceremonial observances.

THE ORIENTAL ORIGIN OF METALLURGY.—M. Ernest Chantre is the author of an octavo monograph upon the Oriental origin of metallurgy, published in Lyon, 1879, by Pitrat Ainé, and containing thirty-two pages of text, illustrated by four plates. The author has given us many able treatises upon the archæology of the Rhone basin, and upon the Age of Bronze. The conclusions to which the author comes in the work under consideration are as follows:

1. The first metal to make its appearance in the West was bronze, and this was during the Stone age.

2. The knowledge of metallurgy, through which bronze supplanted stone as a material of implements, etc., was not the result of the local evolution of industrial ideas; but was due to importation.

3. The Age of Bronze made its appearance in Gaul, as in Scandinavia and in the north, anteriorly to all documentary history.

4. The Age of Bronze had, in France, in Switzerland, and southward, as great a development as in northern countries, and especially as in Scandinavia.

5. The Age of Bronze had in France and in Switzerland a long period of existence, which is proved by the great number of localities, amounting to more than six hundred, and by the total number of objects found isolated and in the diggings, approaching 35,000 in number.

6. The valley of the Rhone is one of the most prolific spots in Europe for bronze antiquities. Here alone about thirty per cent. of the objects have been found, or nearly 11,000 specimens.

7. The importance of the Age of Bronze and the special direction of civilization in this period are demonstrated by the transformations which metallurgy has undergone in each country.

8. These local varieties permit us at present to divide Europe into several archæological provinces with distinct characteristics.

9. Without being able to indicate definitely the origin of metallurgy, we have seen that it was certainly oriental; and that, starting probably from India, it came into Europe rather through Asia Minor than through the Caucasus.

The same mail brought another work by the same author, published in 1878, entitled, "Les Nécropoles du premier age du fer des Alpes Francaises."

Anthropology in England.—Two numbers of the *Journal of the Anthropological Institute* reach us almost simultaneously, that for Nov., 1879, and that for Feb., 1880. The former contains the conclusion of Prof. Flower's paper on the osteology of the Andamanese, and Part III of Mr. Howorth's extended and valuable researches upon the spread of the Slavic race. The February number, however, will be of greater value to the general student of ethnology. The most important papers are the following: On the relations of the Indo-Chinese and Interoceanic races and languages, by A. H. Keane; followed by Notes on analogies of manners between the Indo-Chinese races and the races of the Indian archipelago, by Col. Yule. Mr. Keane's paper will be understood from the following abstract. Five propositions are maintained:

I. Both of the great Asiatic types known as Caucasian and Mongolian have from prehistoric times occupied the Chinese peninsula.

II. The brown races of Malaysia consist exclusively of these two elements variously intermingled, the Caucasian forming everywhere the substratum.

III. The large brown race of Eastern Polynesia (our Sawaiori) consists exclusively of the Caucasian element.

IV. The Negritos, the true Autochthones of Indo-China and Western Malaysia, have been almost everywhere rather supplanted than absorbed by the Caucasians and Mongolians.

v. The Papuans, the true Autochthones of Eastern Malaysia and Western Polynesia, have been rather absorbed than supplanted, the fusion producing the Melanesians in the East, the so-called "Alfuros" in the West.

No room is left for the Malay stock, Mr. Keane holding, "that for science there is no Malay type." Again, we have prominently set forth the discovery of a large ethnical family in South-eastern Asia, allied to the Caucasian and the Malayan, speaking polysyllabic languages, *recto tono;* and it is upon this bridge that Mr. Keane passes from India to the farthest island of the Pacific. Excluding the dark races there are in the Indo-Chinese and Interoceanic area two fundamentally distinct racial types only—the yellow, or Mongolian, and the fair, or Caucasian; and, corresponding to them, two fundamentally distinct forms of speech only—the monosyllabic, spoken *vario tono*, and the polysyllabic, spoken *recto tono*. All the rest is the outcome of incessant secular interminglings. The following is a tabulated list of tribes:

I. General Scheme of Indo-Chinese and Inter-Oceanic Races.

A—DARK RACES.

I. AUSTRAL	Australian, Tasmanian?
II. NEGRITO	Aetas of Philippines, Samangs of Malacca, Andamanese Karons of New Guinea.
III. PAPUAN	Papûans proper, Interior New Guinea, Arfaks, Nufors, Koiari, Koitapu, Aru, Waigin, Salwatty, Mysol, etc. Sub-Papûans East (Melanesians): Admiralty, Louisiade, New Britain, New Ireland, Solomon, New Hebrides, Loyalty, New Caledonia, Fiji. Sub-Papûans West: Gilolo, Floris, Ceram, Buru ("Alfuros"), Timor, Serwatty, Kissa. etc.

B—CAUCASIAN RACES (BROWN).

IV. KHMER BRANCH	Khmêrs proper, Khmêr-dom (Kuy), Sâmrê, Xong, Stiêng, Charay, Cham, Prôôn, Banhar, Cedang, Muong, Khmû, Piâk, Lawa, Xien-Mai, Muang, Lolo.
V. SAWAIORI BRANCH	Samoa, Tonga, Maori, Tahiti, Marquesas, Tuamotu, Hawaii, Tokelau, Ellice, Niuê, Motu, Kerapuno, Mentawey.

C—MONGOL RACES (YELLOW).

VI. Chinese Annamese, Siamese, Laos, Shan, Burmese, Khasia, Karen, Khyen, Talaing?

D—MONGOLOID RACES (OLIVE-BROWN AND BROWN).

VII. MALAYAN BRANCH	Malays, Javanese, Sundanese, Madurese, Balinese, Atchinese, Rejongs, Tagalo-Bisayans.
VIII SUB MALAYAN, PRE-MALAYAN or INDONESIAN BRANCH	Battas, Passumahs, Singkel, Lampung, Dyak, Nias, Batu, Nassau, Sumba, etc.

IX. MIKRONESIAN BRANCH: Pelew, Caroline, Marshall, Gilbert, Ladrones.

II. General Scheme of Indo-Chinese and Indo-Pacific Languages.

A. INDO-CHINESE FAMILY (monosyllabic, toned languages, exclusively on the mainland): Chinese, Annamese, Siamese, Lao, Shan, Burmese, Khasia, etc.

B. INDO PACIFIC FAMILY (polysyllabic languages, spoken *recto tono*).

1. Mainland: Khmêr, Sâm-rê, Kuy, Charey, Cham, Stieng, Banhar, Lawa, Cedang, Muang, etc.

II. Oceanic	Malayan: Malay, Javanese, Sundanese, Balinese, Madenese, Bugis, Macassar, etc. / Sub-Malayan: Batta, Lampong, Rejong, Dyak, Gorontalo, Tagala, Bisayan, Malagasy, Formosan, etc.	Malaysian
	Sawaiori: Samoan, Tongan, Maori, Tahitian, Marquesas, Tuamotu, Hawaii, Motu, etc.	
	Mikronesian. Pelew, Caroline, Marshall Gilbert.	

ANTHROPOLOGY IN ITALY.—The third part of Vol. IX, of *Archivio per l'Antropologia e la Etnologia*, Florence, contains, in addition to a goodly amount of reviewing, the following original papers: Materials for Italian Ethnology, collected under the direction of the Italian Society of Ethnology, by Dr. E. Raseri, pp. 259–289; and The Age of Stone in Perugino, by Dr. Guiseppe Bellucci. The first named paper appears also in another form, entitled, Materials, &c, extracts from the Annals of Statistics, Series 2, Vol. VIII, 206 pp.

The first part of Vol. II, of Anales del Museo Nacional de México presents the continuation of three important papers: The Calendar Stone (La Piedra del Sol), by Sr. D. Alfred Chavero; The Mendoza Codex; An Attempt at the Decipherment of Hieroglyphics, by Sr. Manuel Orozco y Berra; and Annals of Cuauhtetlan.

IN A recent letter to Dr. Hayden, Dr. Paul Topinard, Secretary of the *Revue d'Anthropologie*, and curator of the Museum of the Société d'Anthropologie, expresses an earnest wish to receive all books, pamphlets and extracts, published in America, concerning Anthropology. He remarks that there is now great interest all over Europe on this subject, so far as America is concerned, and that he wishes to make a careful synopsis of all American publications for the *Revue d'Anthropologie*, for popular circulation among the French people. Address, Dr. Paul Topinard, 97, Rue de Rennes, Paris, France.

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GEOLOGY AND PALÆONTOLOGY.

A New Genus of Rhinocerontidæ.—While the genus *Aphelops* must be regarded as the direct ancestor of the recent rhinoceroses with canine and incisor teeth, now confined to Asia and the Islands; the ancestral genus of the African forms and their extinct congeners, which are without the teeth named, is less known. It can now be shown that the missing genus inhabited North America, and that like *Aphelops*, it is hornless. It may be named and characterized as follows: *Peraceras* Cope; superior dentition; I. 0; C. 0; P-m. 4; M. 3; nasal bones weak, hornless.

This genus is established on a new species recently discovered by Mr. R. H. Hazard, in the Loup Fork formation of Nebraska, which may be called *Peraceras superciliosus*. It is founded on a nearly perfect skull, which lacks the lower jaw. Its size is about that of the Indian rhinoceros. It is narrowed anteriorly, but is very wide between the orbits. Posterior to these it contracts rapidly, and rises to a rather elevated occiput. Saggital crest narrow; a prominent angle above each orbit. The premaxillary bone is narrow and weak. The nasal notch extends to above the middle of the third superior premolar. The occiput is rectangular in outline, with truncate summit. Its surface above is concave, divided by a strong median crest; lower down a vertical groove intersects its lateral border. The crests of the molar teeth are rather simple, and the posterior notch is soon isolated on attrition. Wear also isolates an external median fossa of the second premolar. Length of skull from end of premaxillary bone to condyles, M. 700; length of alveolar border of premaxillary, .025; length of molar series, .315; length of three true molars, .160; width of crown of second true molar at base, .075; superciliary width, .255.

This species is nearest to the *Peraceras malacorhinus*, a species which I formerly referred to *Aphelops*, but which I have little doubt belongs to the present genus. It differs from *P. superciliosus* as follows: In the latter species the front is wider, and is plane or concave, not convex; the superior edge of the maxillary is not wide and incurved, and has not the oblique ridges; the infraorbital foramen consequently has a more lateral opening. The nareal notch does not extend so far posteriorly by the one and a half molar teeth. The occiput is wider, is divided by a median crest not found in *P. malacorhinus*, and has the vertical lateral grooves much shorter. The acute supraorbital angle is not seen in the *P. malacorhinus*.

The rhinoceroses of the Loup Fork formation whose generic position can now be ascertained, are the following: *Paraceras malacorhinus*; *P. superciliosus*; *Aphelops meridianus*; *A. megalodus*; *A. fossiger*.—*E. D. Cope.*

The Geology of Southern Arizona.—Prof. E. T. Cox writes us from Tucson, Arizona, as follows: The oldest sedimentary rocks that I have seen in this part of the Territory are limestones, that contain fossils in the same layer, of coal measure, Sub-carboniferous, and Devonian species: *Productus cora*, *P. semireticulatus*, *Spirifer lateralis?* *Zaphrentis* sp.? *Atrypa reticularis*, and *Heliophyllum halli?* I am inclined to place the entire limestone group as Sub-carboniferous. The rock is, wherever seen, semi-crystalline, and the fossils are very imperfect and few in number. The oldest and most persistent crystalline rock is coarse grained granite, which is readily disintegrated by atmospheric influences, and the débris mixed with fragments of the superimposed serpentine trap, basalt, porphyry, and trachites, form the mesa and valley lands of the country, and gives rise to a remarkable topography. The mountains are in low, short and narrow ranges, that seem to rise from the intervening mesas, like islands in an ocean. Where porphyry or green stone form the principal mountain rocks, they are traversed in all directions by quartz lodes or veins, that present bold crops, and in very many instances may be traced for many miles in length. These lodes are never free from ores of precious metals and in some localities the ores are sufficiently abundant to pay handsomely for mining. The Tombstone mines are now about the best paying mines on the Pacific slope. At the latter locality, granite forms the northern border of the low mountains of this precious *graveyard*. The granite is followed on the south by crystalline sub-carboniferous limestone, and the latter by quartzite and porphyry. The limestone appears to be a great mineralizer, and we generally find in it, pockets of the richest ores, assaying from $200 to $10,000 and more, in gold and silver, per ton of 2000 pounds. In localities where limestone forms the prevailing mountain rock, we find numerous and rich deposits of carbonate and sulphurets of copper, cupriferous silver, argentiferous galenite and cerrusite. All the important copper and lead ores that I know of, in Pima county, are found in the sub-carboniferous limestone or at the junction of the latter with crystalline rocks.

The cone-shaped mountains are capped with trachite, which alternates with basalt and trap, and sometimes an amygdaloid-like stone, always honeycombed, as though the once imbedded crystals had weathered out. You will also find on such mountains large beds of calcareous tufa, though not a trace of water can now be found anywhere in the vicinity, evidences of springs long since dried up. On the desert Mesas, between here and Yuma, I find imbedded in the sand and granite gravel, and forming a solid inlaid pavement, perfectly smooth pebbles of trap and basalt, that are polished as smooth as glass, are as black as tar, and glisten as though they had been japanned. Though all are finely glazed, some are covered with little pits. The polishing is done by the

drifting sand, and the black glaze is produced by the action of the hot sun on the oxide of iron, which must be partially reduced to the metallic state. The heat of the sun on the rocks on this mesa will reach fully 150° F for some months, each year, and must produce a powerful effect on the physical character of the rocks. Indeed I am satisfied that if our sedimentary rocks were subjected to strong solar heat and moisture for a period of time, they would be completely metamorphosed. The mesas in this part of Pima county, range from 2000 to 3000 feet above sea level, and the highest mountains are from 8000 to 9000 feet above the sea. The timber on the mesas is locally mesquite, cats' claws (a species of mesquite) and palo verde, and a shrub called by the Mexicans Edonella. At an elevation of 4000 to 5000 feet, we find scrub oak, and 7000 to 8000 feet pine. These elevated regions come within the range of prevalent dew falls. While on the mesas dew is seldom or never seen.

GEOGRAPHY AND TRAVELS.[1]

THE VOYAGES OF THE WILLEM BARENTS AND THE ISBJORN IN THE BARENTS SEA.—The year 1879 will always be memorable in the record of Arctic exploration for the discovery of the Northeast passage by Nordenskiöld, of whose successful voyage accounts have been given in former numbers of the NATURALIST. He has now returned to Europe and been received with great honors at the various cities he has visited on his way to his northern home.

Other less important but still remarkable voyages into the Arctic seas were also made during the last summer.

In the NATURALIST for November, 1879, we noticed the sailing of the Dutch North Polar Expedition in the schooner *Willem Barents*, and of Capt A. H Markham in the yacht *Isbjorn*. Both having returned, an interesting account of their voyages prepared by Capt Markham has been read before the Royal Geographical Society.[2]

The *Willem Barents* found the edge of the pack ice on July 5, in lat. 75° 30′ N., long. 26° E. After stopping at Vardo, the explorers took many deep sea soundings and serial temperatures and obtained dredgings in the Barents sea, arriving in the Matyushin Shar on August 6th. On the 18th they met the *Isbjorn*, and on the 20th they sailed northwards together along the west coast of Novaya Zemlya, soon separating not to meet again. The *Willem Barents*, after placing a memorial stone at Cape Nassau, took a northward course unobstructed by ice on the 54th meridian, and on September 7th they sighted high land, supposed to be Mount Brunn on MacClintock's island, Franz Josef Land, distant about sixteen miles. A broad belt surrounded the land, and the weather being threatening they turned back and arrived safely at Hammerfest on September 24th.

[1] Edited by ELLIS H. YARNALL, Philadelphia.

[2] Proceedings of the Royal Geographical Society, January, 1880.

The *Willem Barents* is thus the first vessel to sight this distant land and return in safety. This success of a small schooner confirms the judgment of those who have, since the return of the Austrian expedition, advocated the route towards the Pole by the west side of Franz Josef Land.

The *Isbjorn*, a vessel of forty-three tons burthen and fifty-five feet in length, though not able to reach quite so high a latitude, made a very interesting cruise. Sailing from Hammerfest on May 25th, they made the first ice on June 4th, about forty miles west of Goose Land, Novaya Zemlya. On June 20th, they entered the Matyushin Shar. "The scenery in this wonderfully formed channel is very grand, more especially on a fine sunny night, when the rays of the sun at a low altitude just 'bathe in deep joy' the summits of the surrounding hills. These lofty ranges raise their crests to the height of from 3000 to 4000 feet above the level of the sea. Between them undulating valleys recede into the interior, covered with such deep snow as to conceal all rocky projections, and make them resemble glaciers in their milk-white opacity, rather than stretches of country which very shortly would be covered with a rich and luxuriant Arctic flora. Occasionally deep ravines, black and sombre-looking, would separate the hills, their dark black cliffs forming a striking contrast to the universal whiteness that everywhere else predominated."

Capt. Markham noticed here the formation of ice on the surface of the water when the air temperature was as high as 39°, the temperature of the surface water being 31°. This was taking place at the mouth of a large valley where a great quantity of fresh water was discharged into the sea. Finding the strait blocked with ice, they coasted along the north-western shore of Novaya Zemlya until again stopped by ice off Cape Nassau, and had to return to the Matyushin Shar, and, after some delay, passed through it into the Sea of Kara. The point of juncture of the tides from the Sea of Barents and the Sea of Kara, was determined to be at a point near Cape Walrus. The ice in the eastern sea was found to be very heavy. One floe Capt. Markham carefully measured, and found to be thirty-one feet in thickness. This floe was over four miles in diameter. Returning to the straits, the *Willem Barents* was met as mentioned above. After their separation the *Isbjorn* succeeded in rounding Cape Mauritius carrying the British flag for the first time to the northward of Novaya Zemlya. Within thirty miles of Barents' winter quarters at Ice Haven, the refusal of the Norwegian crew to proceed further, compelled them to sail in a north-westerly direction. In lat. 78° 8′ N. they encountered a strong northerly gale, and the heavy sea "was a very sure proof that the pack was a long way off." On September 12th, they reached their highest latitude, 78° 24′ N., on the 47th meridian of longitude. They were here surrounded by loose ice. To some of the fragments soil

was still adhering, and this, and their angular, little-worn sides, as well as the increased number of birds of various sorts, some of which are rarely seen any distance out at sea, were convincing proofs of the proximity of land, which, had they not been enveloped in a dense fog, they might have seen. The position reached was about eighty geographical miles from the land discovered by Payer, which Capt. Markham believes extends in a south-westward direction. The lateness of the season now compelled a return, and they arrived at Tromsö on September 22d.

Should an attempt be made in a steam vessel to reach what is probably an archipelago of islands extending from Franz Josef Land to Spitzbergen, it will have a great promise of attaining a higher latitude than has yet been reached, especially when it is remembered that in latitude 83°, Payer saw precipitous mountain land stretching away to the north, while at the same latitude in Grinnell Land it came to an abrupt end.

Capt. Markham's collections are rich and interesting, and include many specimens of carboniferous fossils from Novaya Zemlya which agree almost species by species with those obtained by Sir George Nares at Cape Joseph Henry. It may be safely affirmed that the greater portion of the Polar region is composed of carboniferous rocks, and that the greater part of the Polar sea north of Franz Josef Land and Spitzbergen probably covers a large area of coal measures. The connection of Spitzbergen with the great range of the Ural mountains can now be shown and the beds found there could be correlated with the beds found in Baffins bay and Grinnell Land, so that a distinct belt of carboniferous and Devonian rocks circles much of the Polar region. The northern extremity of Novaya Zemlya is composed entirely of carboniferous rocks which dip beneath the sea under Franz Joseph Land towards the Pole. The identification of these fossils is so complete and certain that the history of these northern rocks now begins to be perfectly well known.

The collection also embraces about ninety botanical specimens, birds, butterflies, fishes, Crustacea and dredging results.

The *Willem Barents* is to be sent out again this summer on a third cruise.

CIRCUMPOLAR STATIONS — THE AURORA BOREALIS. — At the International Polar Conference held at Hamburg, in October, 1879, to consider the scheme of Count Wilczek and Capt. Weyprecht for the establishment of circumpolar observing stations, it was decided to recommend that such stations should be located in the northern hemisphere, on the north coasts of Spitzbergen and of Novaya Zemlya, the neighborhood of the North Cape, the mouth of the Lena, New Siberia, Point Barrow, West and East Greenland about 75° N. lat.; in the southern hemisphere, in the neighborhood of Cape Horn, Kerguelen or Macdonald

islands, and one of the group south of the Auckland islands. These observatories would endeavor to ascertain the answers to the following questions: 1. Are the differences in the daily periods of magnetic disturbances known to us special in the localities, or are they annual phenomena? 2. How are the disturbance-intensities in different places related to each other? 3. Does the disturbance-intensity stand in a determinate relation to one of the fundamental magnetic elements? 4. In what relation do the disturbances on one side stand to those of the other in the different parts of the Polar region? 5. How does the total intensity in the disturbances behave? 6. How far do the disturbances extend? 7. Are there fixed centers of disturbance, or do they form themselves, and shift positions like barometric depressions? 8. In what connection do the disturbances stand with regard to the zone of greatest intensity and frequency of the aurora borealis? 9. In what connection do they stand with regard to the single aurora? and 10, with the different forms of the aurora? 11. What connection is there between the magnetic phenomena of the Arctic and Antarctic regions? and 12, between them and electric earth currents.

Dr. W. H. Dall, in charge of a corps of the U. S. Coast Survey, expects to visit Behrings strait this summer, and if the season permits will go as far as Point Barrow, to enable him to report on the feasibility of establishing a station there.

A correspondent states in the Proceedings of the Royal Geographical Society, as the result of observations taken for many years in Norway, of the aurora borealis, that "the aurora is neither seen during extreme cold or northerly winds, but appears when an ordinary Arctic temperature is raised by southerly and westerly winds, and is generally followed by snow. In the southeastern part of Norway it seems to be especially caused by southeasterly winds, which are there very moist, and rather warm. Its appearance is always accompanied by a falling barometer. In my opinion the phenomenon is due to the following causes. When a wind laden with warmth, moisture and electricity comes in contact with a body of cold air, the moisture is converted into snow, the warmth and electricity are thereby released, and the aurora is the result of the disturbance. The northern lights cannot occur in very high latitudes, because the warm moist air is cooled long before it reaches them." * * * * "The determination of the chemical elements involved, by means of spectrum analysis, is by no means the least of the numerous scientific results to be derived from Arctic exploration."

Another recent writer thus defines the principal zone of the aurora: It begins at Barrow point, lat. 72° N., on the northern coast of North America, passes over Great Bear lake towards Hudson's bay, which it crosses in 60° N. lat., sweeps near Nain on the coast of Labrador, turns to the south of Cape Farewell,

goes between Iceland and the Faroe islands, approaches North cape, rounds Novaya Zemlya and Cape Chelyuskin, nearing the coast of Asia at the bay of Nijne Kolimsk, and lastly, returns to Point Barrow.

Navigation of the Siberian Arctic Ocean.—The New York *Herald* publishes a translation of a paper prepared by Prof. Nordenskiöld, on board the *Vega*, in the spring of 1879, "On the Possibility of Navigation for Commercial Purposes in the Siberian Arctic Ocean." He discusses at some length the routes and best seasons for navigation between the Obi-Yenisei and the Atlantic. As regards the feasibility of the passage westward through Behring strait, he remarks that owing to the rotation of the earth, that portion of the great warm current from the south called the Korosivo, which is deflected into Behring strait, would tend towards the east and not towards the north-west along the coast of Asia, as indicated by many charts. And that there was no such current on that coast, was proved by the investigations made by his expedition. "The currents in the sea or in the large gulf formed by Wrangell's Land, the north east shore of Asia and the north west shore of America, resemble rather the currents of Greenland and of the Sea of Kara. In all those waters a warm current from the south extends along the coast of the land situated to the east, and, in the sea in question, goes from Behring strait to Cape Barrow. All tends to the belief that in the waters north of Behring strait this southern current is counterbalanced—as in the Sea of Greenland and that of Kara—by a current of cold water passing a little to the west of Cape Barrow, at first toward the south, then toward the south-west. This cold current carries along considerable masses of ice formed at a great distance northward, toward the eastern coast of Wrangell's Land, rendering the access to it difficult. In the vicinity of the seventieth degree of latitude the land prevents it from following its route further to the south-west. It is probable that it is then again thrown in a north-west direction, that it traverses Long Sound in doubling the south-west point of Wrangell's Land, and that it again enters into the polar basin, flowing under the currents of the east, which are warm, but little salt, and consequently light, and which are produced by the large rivers of Siberia. It is clear that this current must exert an influence little favorable to the condition of the ices between Cape Schelagskoi and Behring strait. Other circumstances tend, however, to diminish the quantity of ice and produce along the coast an open channel, navigable perhaps every year, at least for vessels of light draught. This coast is situated under a latitude southern enough for the new ice formed along its shores in the winter season to melt in a great measure during the summer, so that at the end of the hot season there remain only great mountains of ice, agglomerated in

winter, or descending with the winds and currents from colder northern regions. Most commonly this large ice is so deep that it is grounded at 5.34 metres to 8.91 metres of water. Now, as the depth of the sea diminishes generally in a uniform manner toward the shore (save where mountains project in promontories), there remains a free channel very wide at the immediate proximity of the shore. A vessel not drawing more than twelve feet can float in all security in this water." Prof. Nordenskiöld closes with the following recapitulation:

" What I have said may be summed up in the following points:

" *First.*—This route by sea from the Atlantic to the Pacific along the northern shores of Siberia ought to be frequently navigable in a few weeks by a suitable steamer having aboard experienced mariners; but it is not very probable, from the knowledge that we actually possess of the Ice sea of Siberia, that this route will become in its totality of great importance to commerce.

" *Second.*—It may already be given as a thesis that there exists no difficulties for the utilization, as a commercial route, of the sea between the Obi-Jenisei and Europe.

" *Third.*—According to all probability the route by sea between the Jenisei and the Lena and between the Lena and Europe can be equally utilized as routes of commerce, but the going and returning between the Lena and Europe cannot be effected in the course of the same summer.

" *Fourth.*—Ulterior explorations are necessary to decide on the possibility of maritime commercial relations between the mouth of the Lena and the Pacific. The experience acquired by our expedition shows that in any case there can be introduced by that route from the Pacific into the basin of the Lena, in steamers, heavy engines and other effects which cannot be transported conveniently on sledges and wagons."

The entire absence of scurvy during the voyage of the *Vega* is attributed by Prof. Nordenskiöld to the free use of a curious little berry that springs out of the eternal ice and snow during the short summer. It bears profusely, and has a taste like the raspberry but more acid. The fruit is dried and then mixed with the milk of the reindeer, and can be carried frozen for thousands of miles. Lieut. Hovgoard states, as another reason for the good health of the party, that on no occasion was the daylight quite wanting and even on the shortest day, although the sun did not rise above the horizon, there was a couple of hours of daylight.

As experiments recently made in England show that vegetable and plant life is produced and stimulated as well by the electric as by the sun's light, its use on board of vessels in the Arctic seas might be found advisable not only as a promoter of comfort and cheerfulness but as a direct sanitary agent.

The Danish steamer, *A. E. Nordenskiöld*, which was sent out by M. Siberiakoff to the relief of her namesake, and was stranded in

August, 1879, off the east coast of Yesso has been gotten off safely. She will be refitted, placed under the command of Capt. E. Johannesen, who discovered Ensomeheden island, and will attempt the north-east passage in the reverse direction.

"DIE METAMORPHOSEN DES POLAREISES."—This is the title of a valuable work by Capt. Weyprecht, recently published in Vienna, and treating very fully of the character, changes and movements of the Arctic ice.

The first chapter speaks of the three different kinds of ice-glacier, salt-water and fresh-water. This is followed by others discussing ice-pressures, ice in winter and in summer, and the changes in its surface caused chiefly by variations of temperature between the water below and the air above—these effects being often increased by the banks and mounds of same. The weight of these snow masses, the pressure of surrounding ice-fields driven by the winds or currents, and the forcing of large blocks over and under the ice surface are also effecting constant changes in the surface of the frozen sea. These changes are accompanied by frequent noises. Sometimes only a mere murmur is heard, but often there is a groaning and roaring as if heavily laden wagons were running over the icy surface.

Noise is conducted a long distance on the ice, and sounds at the margin of the floe often seem directly under your feet. "Whenever" Capt. Weyprecht says, "I laid down to sleep, and placed my ear against the ship's side, a humming and confusion of sounds could be heard—the combination of noises on the ice at great distances from the ship." The movements of the ice—each field possessing a different velocity, the different effects caused by the winds and currents on the various masses, owing to the irregularities of the upper and under surfaces of the fields, the slow movement of the great iceberg and the rapid velocity of many ice-fields are also pointed out as characteristic features of Arctic ice heretofore little understood.

It is to be wished that Capt. Weyprecht's investigations had extended to the shores of the Palæocrystic sea of the British expedition, where most of these phenomena are visible on a grander scale than can elsewhere be witnessed. Our knowledge of Arctic ice must continue to be very incomplete until we learn more of the origin and duration of these mightiest of all known ice masses.

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SCIENTIFIC NEWS.

— The Count de Castelnau, for many years French Consul at Melbourne, died there recently. He was an ardent student of natural history, and had pursued his studies in the various parts of the world whither his official duties led him. He was director of the scientific expedition sent by Louis Phillippe, the King of

the French, to South America, and was afterward French Consul in divers parts of the southern hemisphere. While at the Cape of Good Hope he wrote a "Memoire sur les Poissons de l'Afrique Australe." When he returned to Europe and began to put his voluminous scientific notes in order, he made the disheartening discovery that while he had been temporarily disabled, his servant had been for more than a month in the habit of using the sheets of paper on which he had bestowed so much time and labor to light the fires. He disposed of the remainder of his notes and drawings to Prof. Lacordaire, and about 1862 arrived in Melbourne, where he has since resided. Count Castelnau was an active member of the Zoölogical and Acclimatization Society of Victoria. He contributed several valuable papers on the fishes of Australia, which have been published by the society, and are recognized by naturalists as works of authority on the subject. His large work in six volumes on his exploration of South America, is one of the most valuable authorities upon the interior of Brazil, Bolivia and Peru.

— Mr. Seth Green says in a letter to the *Tribune:* "I am informed by Mr. McPherson, a fish dealer at Sackett's Harbor, that over five hundred shad, weighing from two and one-half to four pounds each, were taken in white fish nets set in deep water, off Sackett's Harbor, in Lake Ontario, during last summer. Their stomachs were full of the common food of the lake, showing that they feed in the lake, and the chances are that they never have been to salt water, and that we have added a new fish to the waters of the lake. I have opened thousands of shad taken in the Hudson, Connecticut and Potomac rivers, and hardly ever find anything in their stomachs. I think they have become landlocked, and will make Lake Ontario their home."

— A Baltimore Naturalists' Field Club has been recently organized, with its headquarters at the University. Prof. Martin is its president. The object of the club is to study the fauna, flora and geology of the neighborhood of Baltimore, to make collections illustrative of the above objects, and to accumulate data for an accurate map of the region, which shall be of use to all students of its natural history. Sections have been organized in botany, vertebrate land animals, invertebrate land animals, aquatic animals, geology and physical geography. It is proposed to make weekly excursions on Saturdays, and to hold monthly meetings at the university.

— Dr. Theodore Gill has now charge of the fish department of the Chicago *Field*, and Mr. W. H. Ballou of the natural history department. In a late number Dr. Gill published an important article on the nomenclature of the fishes mentioned in popular American books on fishing.

— The annual meeting of the Entomological Club of the American Association for the Advancement of Science, will be held at the Museum of the Boston Society of Natural History, corner of Berkley and Boylston streets, Boston, commencing at 2 P. M., August 24, 1880. It is proposed to send to every member of the American Association, and to all others who may favor the undersigned with their address for that purpose, a circular announcing the special subjects which will be presented at the meeting of the Club, and therefore, all entomologists who desire to read communications at that time, are requested to notify one of the undersigned before August 1st. This will insure a fuller discussion of the topics presented, and, it is hoped, a larger attendance. Samuel Scudder, president, Cambridge, Massachusetts; B. Pickman Mann, secretary, Cambridge, Massachusetts.

— By the last annual report of the Zoölogical Society of Philadelphia, we learn that the average number of visitors daily, last year was 591. The receipts continue to more than pay expenses, and we are glad to learn that the society has received from the executors of the will of J. W. Miller the sum of $20,000. A goodly number of animals were received. A number of boas died during the winter of a disease showing a diphtheritic condition of the alimentary canal, probably contagious in its nature. The number of animals in the garden is 942, of which 392 are mammals and 415 birds.

— Many naturalists and directors of museums may be glad to learn that Mr. J. S. Kubary, long connected with the museum Godeffroy in Hamburg, is ready to undertake the collection of specimens and information in the various branches of zoölogy and ethnography in the Pacific islands. Mr. Kubary is now in the Caroline islands, where he has been under the exclusive employ of Herr Godeffroy. The address is Joh. S. Kubary, Mpoma, N. W. Harbor, Ponape, in care of H. B. M. Consul in Honolulu.

— Dr. F. V. Hayden has recently been elected honorary member of the Yorkshire Philosophical Society, York, England; the Italian Geographical Society, Rome, Italy; the Scientific Society of Styria, Graz, Austria; the Society for the Advancement of Natural Science, Marburg, Prussia, and Verein für Erdkünde, Dresden; also corresponding member of the Société des Sciences Physiques et Naturelles, Bordeaux, France, and foreign associate of the Société d'Anthropologie de Paris. The "Société de Topographie," of Paris, has also awarded him a medal of the first class for his geological and geographical works.

— The herbarium of Dr. C. C. Parry, the distinguished botanist of many government and other expeditions, has been presented to the Davenport Academy of Sciences. It contained 15,000 named species.

— Our series of articles regarding progress in the different departments discussed in the NATURALIST, have, according to a number of letters, domestic and foreign, been highly approved by our readers. It is to be hoped that we may be encouraged to render this a permanent feature of the magazine by additions to our subscription list.

— The report for 1879 of Mr. W. A. Conklin, director of the Central park menagerie, states that the total number of animals exhibited was 1206. A goodly number of mammals and birds were bred in the menagerie. The most valuable animals on exhibition, were two black leopards, four polar bears, a two-horned rhinoceros, and a sea lion and cub.

— About half the skeleton of a *Camarasaurus*, obtained by Prof. Cope, last summer, has been shipped to Philadelphia. The bones are well cleared of rock, and fill twenty-five boxes, which weigh 6850 pounds. The complete skeleton would weigh about six tons. The bones are to be deposited in the Permanent Exhibition Building.

— We notice large numbers of mussels for sale in the fish markets of Providence, R. I., where they have been sold for some thirteen years, being bought largely by English people. We have not before heard of the edible mussel being used as an article of food on this side of the Atlantic. They are sold mostly in summer.

— Mr. A. H. Swinton, of Binfield House, Guildford, Surrey, England, desires subscriptions (price, 7s. 6d.) for a work on "the causes which propagate, distribute, and modify insects." The book will treat of the organs of sense, secondary sexual characters, and variations in insects.

— Pierre Henri Nyst, conservator of the Royal Museum of Natural History of Brussels, died on the 6th of April, in the 67th year of his age. He was well known as one of the first of the Belgian geologists and palæontologists.

— The Boston Society of Natural History celebrated the fiftieth anniversary of its foundation by a special meeting in its museum, April 28th, when addresses were made by President Bouvé, Prof. W. B. Rogers, and others.

— The French Government propose to spend nearly $500,000 in experiments calculated to drown out the phylloxera in about 18,000 acres of vineyards in L'Aude and L'Hérault.

— Prof. W. K. Kedzie, a successful teacher of chemistry and well known for his attainments in geology and zoölogy, died at Lansing, Mich., April 14th, aged thirty-nine years.

— A catalogue of the fungi of the Pacific coast, by Dr. H. W. Harkness and Justin P. Moore, has been published under the auspices of the California Academy of Sciences.

— The Harvard Library Bulletin, No. 15, contains the beginning of a bibliography of fossil insects, by Mr. S. H. Scudder.

— It is announced that Mr. Darwin has nearly or quite ready for publication, a work on the Circumnutation of Plants.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences, May 17.—Prof. T. Eggleston read a paper on the origin of gold nuggets and of alluvial gold deposits.

May 24.—Prof. J. S. Newberry remarked on the flora and fauna of the Triassic rocks about New York; and Mr. G. F. Kunz spoke regarding the fluor spars and certain associated minerals from Missouri and Southern Illinois.

May 31.—Mr. A. A. Julien presented his observations on the Palisade range at Weehawken, N. J., and on quartz crystals as an element in the constitution of rocks.

Boston Society of Natural History, May 19.—Dr. C. S. Minot remarked on the tongue of reptiles and birds, and Dr. M. E. Wadsworth on the age of the copper-bearing rocks of Lake Superior.

American Geographical Society, New York, May 25.—Rev. B. F. DaCosta read a paper on Arctic explorations, ancient and modern.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

American Journal of Science and Arts.—June. Physical structure and hypsometry of the Catskill Mountain region, by Arnold Guyot. Occurrence of true Lingula in the Trenton limestone, by R. P. Whitfield.

Canadian Naturalist.—May 7. The history of some Pre-cambrian rocks in America and Europe, by T. Sterry Hunt. Notes on some Canadian ferns, by J. Campbell.

The Geological Magazine.—May. Notes on the Anomalocystidæ, a remarkable family of Cystoidea from the Silurian rocks, by H. Woodward. Notes on the history of the extinct Carnivora, by P. N. Bose. British carboniferous tubicolar Annelides, Part III, by R. Etheridge. Dr. H. Frautschold on the level of the sea.

Zeitschrift für Wissenschaftliche Zoologie.—May 7. Anatomy of *Tænia perfoliata*, by Z. Kahane. On the Tyroglyphi and allied mites, by G. Haller. On the structure and development of *Bursa fabricii*, by L. Stieda. On the primary stone canal of the Crinoids, with remarks on the comparative anatomy of Echinoderms, by H. Ludwig. New contributions to the anatomy of Ophiurans, by H. Ludwig.

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THE FABRICATION OF AINO CLOTH.

BY PROF. D. P. PENHALLOW.

IN view of the very uncertain history of the Ainos, it is difficult to obtain reliable information respecting the origin of any of the rude arts with which they appear to be familiar. According to the testimony of the Ainos themselves, weaving has been practiced by them from very early times, while their traditions also state that their knowledge of the art was original and not obtained from the Chinese or Japanese. There appears but little either in support or contradiction of such statements, other than can be obtained by a comparison of the machines used by the Ainos and their Japanese neighbors. Those used by the former involve a simplicity not to be found in any of the Japanese instruments, pointing to originality or marked deterioration in the first case, or, in the second, a greater improvement of original forms than has generally been recognized as a feature of the old style of mechanical ingenuity. While the whole subject is involved in its present obscurity, we can only look upon the statements of the Ainos as of traditional interest.

The fabrication of the cloth involves processes and implements of the greatest simplicity, such as may readily be executed or procured under the conditions of a wild forest life. The material used is coarse bast fiber obtained from two species of elm, *Ulmus campestris* and *U. montana*, respectively known to the Ainos as Akădamo and Ōhĭyo. The slight maceration or simple bruising to which the fiber is subjected, results in nothing more than a separation of the various bast layers, no attempt being made to separate individual fibers and produce twisted threads; hence we

find the prepared material very coarse, and the finished product correspondingly so.

As a class, the Ainos are not yet susceptible to the demands of higher and increasing wants. Their desires are few, of a low order, and easily satisfied; and in the matter of clothing, it is sufficient for them to know and feel that their one garment satisfies the demands of decency, that the material costs only the expenditure of time—which, to them, is nothing—and that the processes of preparation and fabrication are both simple and easily accomplished. Delicacy of touch, pliability, fine texture and a pure color are considerations which do not find place in the Aino mind, yet with an exhibition of the truly savage taste which delights in a display of rude and brilliant ornamentation, we find them expending great effort upon their garments to secure striking, if not altogether symmetrical and harmonious decoration.

The collection and preparation of fiber, though properly belonging to the women, is not unfrequently undertaken by the men in connection with their own peculiar work. Thus with a hunting expedition, which may last several days, they often combine the object of collecting bark, either for cloth or the manufacture of ropes; while their visits to pools where the bark is macerating, will be combined with a search for their principal source of farinaceous food—lily bulbs.

The bark is generally drawn from the standing tree. Three or four good blows with the heavy knife, which every man carries, suffice to permit a good hold with both hands, when by the exercise of a little skill, a strip of bark nearly a foot wide, is drawn off quite up to the branches, often a distance of twenty feet. If taken from the Ōhīyo, it is macerated for about ten days in quiet pools of tepid water, such as are common about the borders of swamp lands. As soon as sufficiently macerated, the outer bark readily separates from the bast portion, when this latter is again split into long and broad strips, usually about ten in number. These are then dried slowly to prevent rendering the fiber brittle, after which they are stripped into threads having an average width of one-eighth of an inch. No twisting or other process is performed, but as soon as the threads *(Āh)* have been made of the proper size, they are joined together by a simple square knot, and nicely wound in balls, five inches in diameter, which unwind

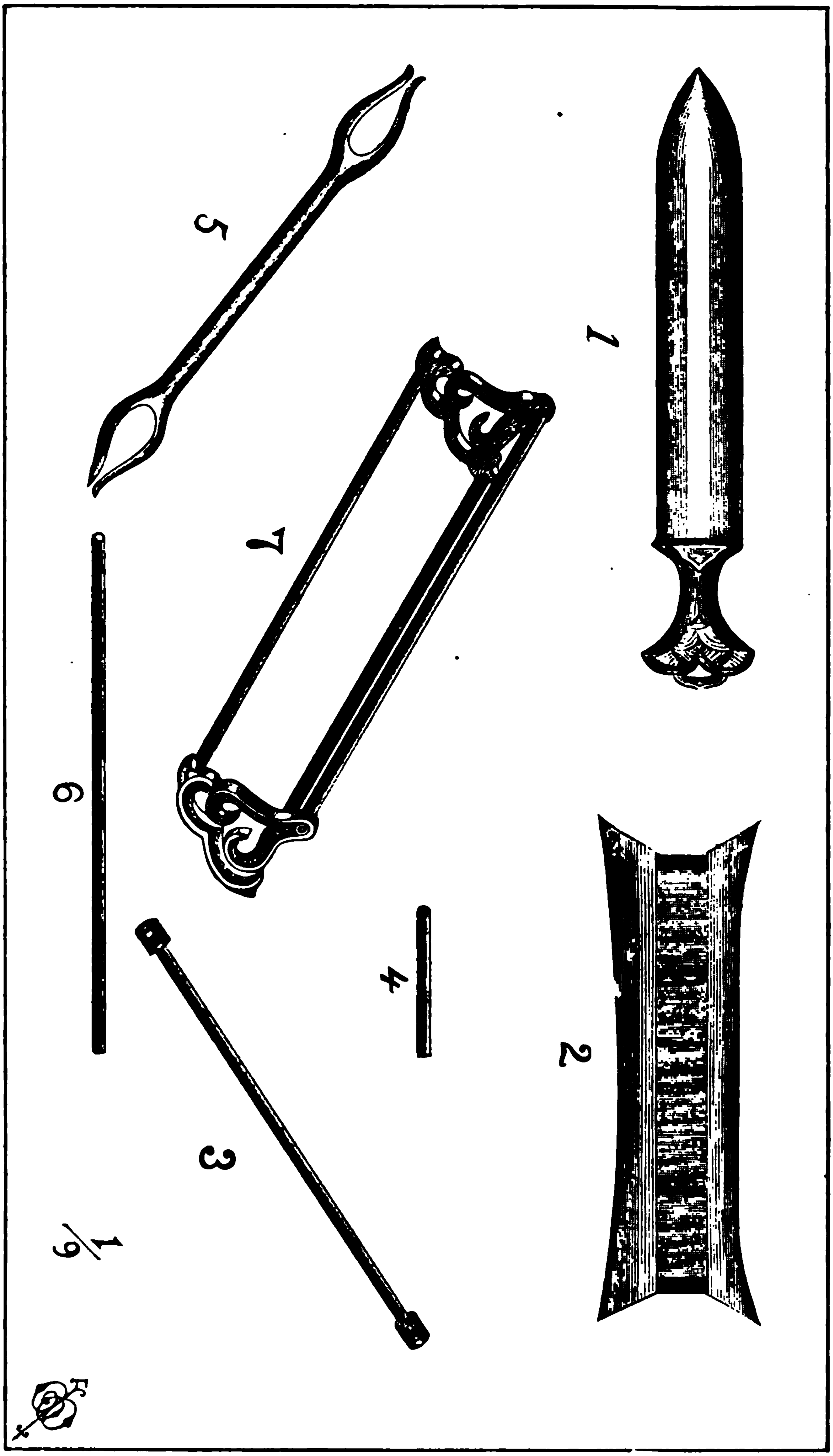

PLATE I.—Instruments used in weaving Aino Cloth.

from the interior. The bark of the Ākădamo is not macerated, but as soon as gathered, the outer bark is separated from the bast. The latter, in strips about three inches wide, is repeatedly doubled and thoroughly broken by the *teeth* at the point of folding. By this means it is soon possible to separate the various layers of bast without any difficulty. The subsequent treatment is the same as of the Ōhīyo bark.

The instruments employed in weaving are but seven in number, and while they are of great simplicity, they seem quite efficient for the class of work demanded. They may be enumerated as follows:

No. 1. Be′ra.
" 2. Ō′sha.
" 3. Be′kofune.
" 4. Ădă′te.
" 5. Ăho′nishi.
" 6. Yō′dosini.
" 7. Gă′masa.

With the exception of the bera, which is usually maple, all the implements are made of some soft wood, such as pine. The only instrument used for making and carving them, is a small sheath knife, having a slightly curved blade about six inches in length. Oftentimes the Aino will call into requisition all his skill in carving, to produce an elaborate set of instruments, while in the majority of cases they are left quite plain. The general forms and sizes will be understood from the accompanying figures. With the exception of Figs. 1, 3, 7, the instruments are perfectly plain. In the ōsha, Fig. 2, the bars are of such number as to admit the use of one hundred and sixty-five warp threads. The bera is used only for the purpose of tightening the threads. The ăhonishi, or shuttle, usually holds enough thread to complete about three feet of cloth.

To prepare the threads for the loom, several sticks, one foot long, are driven into the ground constituting the house floor, arranged as shown in Plate II, from 1–7. The number and distance apart, vary according to the length of the threads to be used, consequently of the cloth to be made. Two balls of thread, prepared as previously described, are then selected and unwound together, thus greatly facilitating the operation. The threads start at 1, turn 2 and pass around peg 1 again, thence to 4-3, and so on, when after passing the last peg, 5, they return

over the same course to 1. This process is repeated until, without counting, the operator thinks she has enough threads to fill

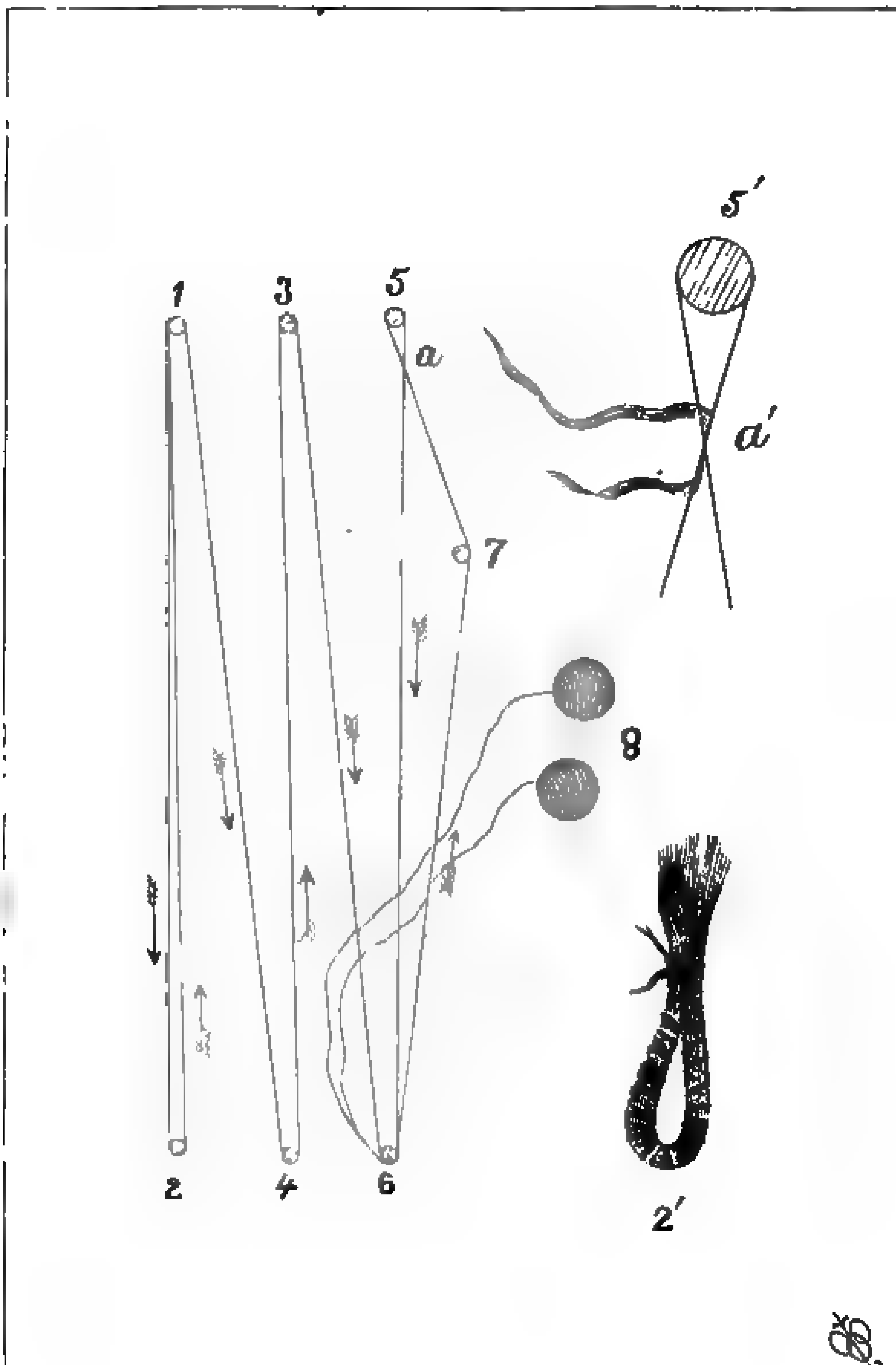

PLATE II.—Method of Stretching and Tying Warp threads.

the loom. Between pegs 5 and 6, the threads are crossed each time by a simple twist, as shown at *a*, and secured by a side peg,

7. Thus is accomplished the crossing which, later, serves to separate the woof threads. The proper number of threads obtained, they are tied at various intervals, a strip of bark is passed each side of the cross at *a*—shown more distinctly at *a'*, Fig. 5'—to keep the threads from uncrossing, and the loop at 2, shown in Fig. 2', is well wound to keep the threads of each series distinct. The pegs are then drawn, and the operator has a single bundle of threads with a loop at each end. The loop of each thread at 5 is then passed through the ōsha, so that the latter will be between the crossing *a'* and the longer portion of the threads. The yōdosini is next passed through the loop 5, and serves to keep the threads in position, as well as a straining stick by which the warp may be kept at proper tension. At a distance of four or five feet from the ōsha, the ādate is secured to the threads and passed through a looped string fastened to some firm object. By means of a string passing around the body, and secured to each end of the yōdosini, the operator, who sits upon the floor, can easily regulate the tension of the threads by bringing all strain upon the ādate. The gāmasa is placed within a few inches of the ōsha, but between it and the cross of the threads; its only use is to properly separate the upper and lower series of threads, to permit the action of the ăhonishi. The bekofune occupies a position near the gāmasa, about one-half way between it and the yōdosini. Small twine is then passed over it and looped under each warp thread of the lower series, thus forming a simple means of bringing either series of threads to the top, and varying the cross of the warp to correspond with the movement of the ăhonishi. The position of parts will be readily understood from an inspection of Plate III.[1]

The size of the cloth is quite variable, since the Ainos seldom count and have no means of accurate measurement. Thus if in stretching the warp threads the operator obtains more than enough to fill the loom, the extra ones are dropped out and the cloth will have a maximum width of 13.5 inches. If, however, not enough threads were taken to fill the loom, no more are added. The usual length of the cloth is six and a-half times the

[1] EXPLANATION OF PLATE III.—1. Gamasa. 2. Ōsha. 3. Bekofune. 4. Yōdosini. 5. Adate. 6. Position of operator. *a'* Cross of threads = *a'* Plate II. A. Pattern for front skirt of coat. B. Pattern for collar. C. Pattern for cuff.

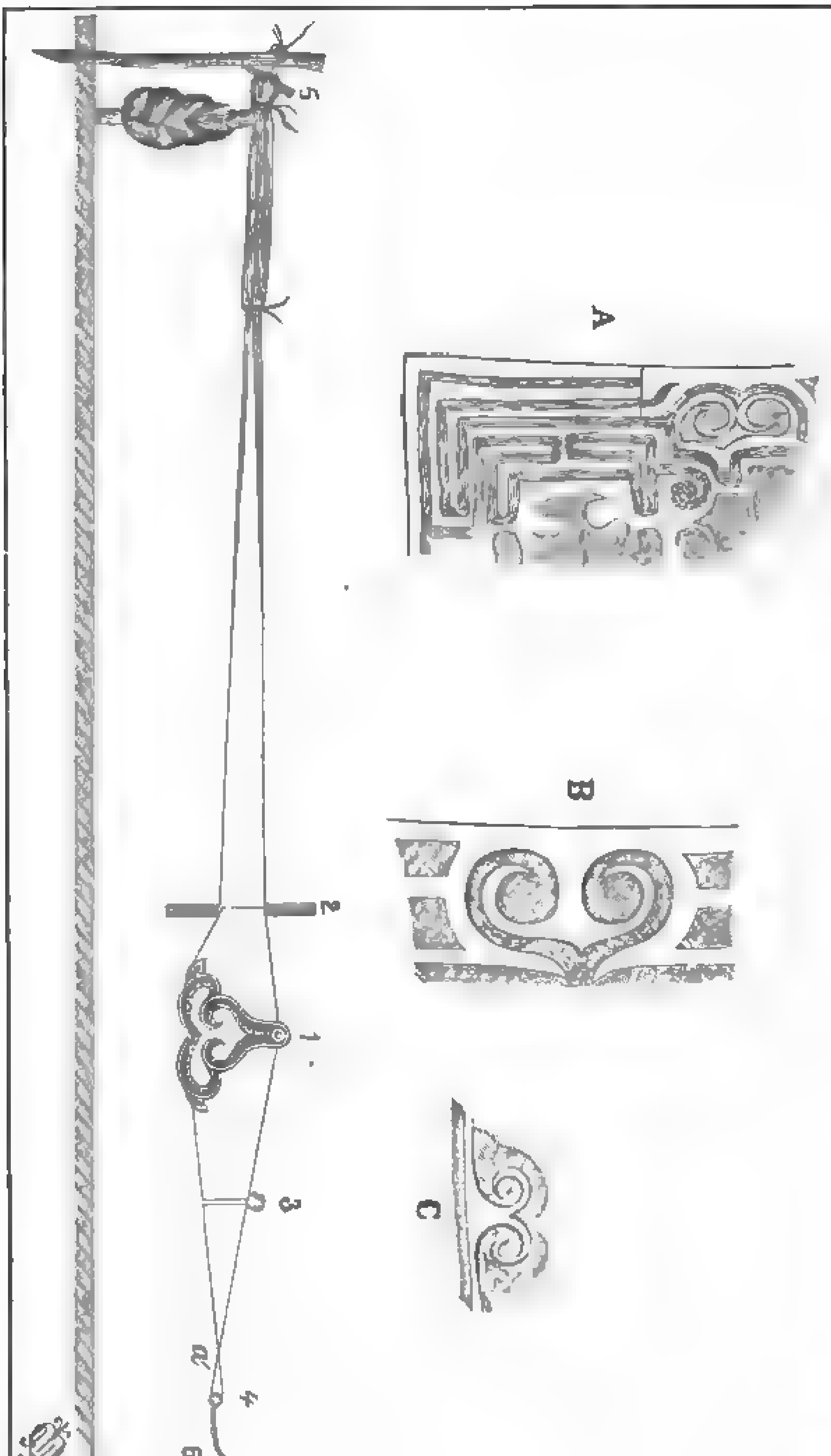

PLATE III.

length of the expanded arms, and as this latter will average five feet, we find the total length of cloth approximating thirty-two feet in round numbers.

After the thread has been prepared, such a piece of cloth can be made in from three to four days, according to the skill of the operator, who is always a woman.

The color of the finished fabric is always that of the bark from which it is made, though uniformity is rare, owing to discoloration of the threads during preparation. If made from Ōhĭyo, the color is usually brown, with slight inclination to red, while that made from the Ākădamo is invariably of a bright tan color.

As an article of clothing, for which use alone it appears to be utilized, the Aino cloth has several good qualities. It is very coarse in texture, as would be expected from the nature of the material, but it possesses great strength and wears out slowly; while its meshes are so close, and the threads so compact, that it is completely proof against ordinary rains, on which account the Japanese make great use of it for rain coats.

The Ainos make yet another kind of cloth out of fiber obtained from a species of *Urtica*. This, however, is only made in small quantities, since its use is restricted to burial purposes.

The garments are made in the most simple manner, the breadths being cut without any bias. Nearly all are ornamented with some simple figure, either blue or white, though red and green are not unfrequently used. Plate III will show some of the most characteristic patterns, which were copied from the dress of a chief's wife, and are very good representations of the more elaborate forms.

In addition to the buskins the only garment worn is a coat reaching somewhat below the knees, and fastened at the waist by a girdle. Upon this one garment the women often lavish all their skill in decorating, and thus the coats of chiefs—more especially their wives and children—not unfrequently make a great display of gaudy trimming. The ornamentation, however, often lacks greatly in symmetry, as can be seen by the figures.

ENGLISH BIRDS COMPARED WITH AMERICAN.

BY H. D. MINOT.

FROM April 22d to September 9, 1879, except for a fortnight in Scotland, I was in England, passing through all but two of her forty counties, and in many of them staying long enough to study their natural history attentively. Unfortunately, however, there were so many other objects of absorbing interest, that I did not become so familiar with the birds as would have been pleasant, and I often was obliged to slight their most attractive invitations.

To compare English birds with ours, I have no hesitation in saying that they are less abundant; but, on the other hand, in spite of extensive wild lands, their companionship is more readily obtained, and the naturalist need not seek for birds so often as he must here; for the respect and consideration shown them there, give some of them, at times, almost a social ease with man. They are not free, of course, from school-boys and human enemies of other kinds (especially are the song-birds persecuted by professional bird-catchers); but the public at large are more reasonable in their instincts and customs than the free and thoughtless American, who must fire his gun whenever he gets a chance, regardless of all true interests concerned. This I can illustrate from my journal and recollections. To the unforewarned there is a curious disappointment in traversing the great English "forests," so called, where trees are an unimpressive or absent feature; but, for my disappointment in the "New Forest," I was compensated by my pleasure in Ringwood, a delightful little village of Hampshire, on one of the rivers Avon, near the South coast. There, on one of those rare and pale moonlight evenings, which in England last summer were almost legendary, as I stood on the village-bridge, looking over the broad meadows, I was surprised to find both moorhens and wild mallard nesting undisturbed, within not many rods, and making themselves quite public. The home-naturalist of the place told me that in former years a few of their eggs might have been taken, but that he believed they were never shot there in their breeding-season. Among a people notorious for their love of sport, this sensible respect for law and nature is of the highest value. From this single circumstance we might judge too favorably; but there is

other evidence of a better public spirit in some respects than we can boast; such evidence as the tameness in spring of the common partridge and of the ring dove, and the abundance of the latter after centuries of civilization.

These wild pigeons, though heavier than ours, have a more than correspondingly slower flight; and it is curious to observe how heavy the English atmosphere seems to British birds, and how general it makes this difference in speed. At least, I do not think that I was misled by his larger size into noting that the European swift was much less quick and dashing than his American cousin; and I am sure that the grouse which I was allowed to put up on the moors, could never test the sportsman's skill in rapidity of action so well as any of our game-birds proper. These moors in Derbyshire, by the way, were the only place in England where I met with mosquitoes, though later in the summer-season, while out doors, I was sometimes as much bothered by flies as in our own woods. There is, however, a comparative want both of cheerful and of annoying insect-life. I may here add of England that, though, to be sure, last summer's weather was peculiarly unfortunate, I generally found the walking bad, and the air neither exhilarating nor soothing. The equable temperature certainly gives ease to out-door life; but freedom from enervating heat was offset by subjection to depressing wet.

Though I wish to avoid the worst fault of a critic, that of fault-finding and depreciation, I believe I may justly say that as the birds of England are inferior to those of New England in variety, so are they, on the whole, in coloring and in song. Her kingfisher may be as tropical in brilliancy as our hummingbird; her thrushes, swallows and finches as pretty as any other of their tribes; but with the exquisite and delicate beauty of our wood-warblers, and with the splendor of our tanagers, orioles and starlings, she has almost nothing among her familiar friends to compare. Then, among her song-birds, of whom I heard nearly all, she has none corresponding, as musicians, to our hermit thrush, house wren, water warbler, solitary vireo, song sparrow, or rose-breasted grosbeak; yet all these, and many kindred that I might associate with them here, are good singers. To all her song birds (that I have heard), on the contrary, except two or three, we have singers corresponding, and to all absolutely, I may say without prejudice, equals or superiors, as well as I can judge.

Of the nightingale my judgment is perhaps formed on imperfect evidence; for, as last year abroad, winter lingered in the lap of spring, and, indeed, even clung to the skirts of summer, these birds would not sing where and when they ought to, and for much of the spring I was outside of their bounds, so that finally I heard them but one evening in the very last of May. I must confess that there was everything in my circumstances then to disgust a concert-goer and to annoy a critic. In that higher latitude daylight did not fade away till nine o'clock; and, until their bed time fairly came, song thrushes and blackbirds sang their loudest notes. These interruptions would have been tolerable, perhaps, had they not in turn, in that much frequented spot, been interrupted by trains, dogs and noisy loungers, while a high wind seemed to sweep away the notes I tried to catch. Still, by means of a friendly companion, of oft-read descriptions, and of an unmistakable character, I recognized and heard these notes before the cold evening silenced them altogether. I estimated that the nightingale had a most wonderful compass, and was the greatest of all bird *vocalists*, but with a less individual and exquisite genius than our wood thrush. Yet, to hear that delicious, soft, liquid warbled trill, which she alone can give, was a lasting pleasure.

Scarcely less famous, and much more familiar, is the skylark. Him I saw and heard a thousand times, spring and summer, morning, noon, and night. His flight is indeed astonishing, though exaggerated by report. I have lost him among the clouds, when, as often happened, the sky hung very low, and on clear days have strained my eyes to follow him; but I think that half a mile was full the greatest height he reached. His song is an unbroken, ecstatic torrent; but it is shrill, slightly harsh, and not very musical. It is not so rich as our bobolink's roundelay; and its sweetest notes, though they suggest, do not equal the canary's song, except for their intensity of utterance. All his poetry, and the secret of his charm, is in his flight. Look at him spring from earth, watch him rise with quick, pulsating wings, as if borne up by the impulse of his song, until your eye is almost baffled by his elevation, then behold him suddenly, as if overcome by love for mother-earth and home, drop headlong, still seeming to sing passionately, until, at the very last, he spreads his wings, to float down calmly to his rest—and have you not seen one of nature's true poets?

A more fascinating poet to me, however, whose song was full of sentiment and most individual (and curiously enough the only new type of bird-song that I heard while abroad), was the wood lark. To hear him as I did, you must wander on some heath, and to enjoy him must be near: his delicate notes are but weak, if feebly heard. The bird, easily distinguished on wing by his smaller size, cocked tail, and much shorter flight, does not even seem to circle, but rises at one angle and falls at another. His song is the repetition of a delicate whistle *(ch'wee)*, shrill at first, intensifying as the bird rises, and, as he drops, falling in tone and pitch, so as to die away upon the ear. It is exquisite.

Another singer of high repute is the song thrush. Her beautiful music is most like our brown thrush's, with something, however, of a wood thrush flavor; but it has less variety and occasional harsh notes. The blackbird's music, though often more nearly whistled, is very similar, but, I think, is finer, being richer and more liquid: at times it is exceedingly delightful. The wren sings with characteristic sweetness and power: her little outburst distinctly suggests that of our wood wren (and the canary's too); but it is slenderer in every way. Then, the blackcap's song is sweet, joyous, and rather varied; yet it seemed to me of no great merit, though altogether very pleasing. Of the linnet, perhaps most esteemed as a cage-bird, we have various representatives; and of the chaffinch, most celebrated as the *pinson* of the French, I must say that he is a tiresome little bird: he is pretty, and so is his song; but, from its monotonous simplicity and abundant repetition, it becomes wearisome.

Robin redbreast is charming, both in himself, and because he's not unlike the blue bird, whom his plaintive little warble oft recalled, besides suggesting to my mind the meadow lark. It may sound feeble and shrill, at times; but hear it in a church or ivied ruin, and its repeated tenderness, neither joyous nor sad, at once creates an association that gives it a perpetual charm. The redbreasts, being hardy, insectivorous, peaceable and pleasing, might, I believe, have been introduced into this country a few years ago with great satisfaction. As to the house sparrow, such as we did import, having gone abroad in part for change and rest, I did not undertake to study them while there, or to gather home-opinions on them; but I was delighted, almost my first day among English birds, to meet a genuine old Englishwoman who

voluntarily assured me that the year before she was "nigh *h*'eat *h*'out of 'ouse and 'ome by them sparrows!"

The naturalist traveling through England is much assisted by her museums. Though, after a hasty review of its natural history department, I flattered myself (but then in flattery there is often deception) that the British Museum did not have so fine a collection of birds as has our Boston Society, yet with some of the local museums I know nothing in this country to compare. Salisbury, for instance, a town with no large population, had a museum, which, purposely and wisely local in character, instead of attempting an ostentatious display, confused and vastly incomplete, of a world-wide gathering, had, in its ornithological department, a simple, thorough and admirable collection of British birds, which artistically, taken all together, were the best mounted I had ever seen. What an easy Natural History to read, and what a pleasant guide-book to that neighborhood! At Torquay, if I remember right, the collection was still more local. I wish that our people would be content, outside of their great central museums, to imitate these examples. I fear that they are too eager, ambitious, and fond of show; though perhaps, should I spend five months in traveling through the towns of New England, I might in this matter be agreeably disappointed. To the proper protection of living birds, however, and to the reasonable preservation of Nature, the American people certainly pay no sufficient heed.

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ON THE AGE OF THE LARAMIE FORMATION AS INDICATED BY ITS VEGETABLE REMAINS.

BY J. STARKIE GARDNER.

I SHALL confine myself to such inferences which bear on the question of the age of the Laramie formation, as have been drawn from a consideration of the British Eocene floras alone.

In the first place it is desirable to consider carefully the extent of the gap between the Cretaceous and the Eocene formations in Europe, as it is probable that a portion of the strata whose age in America is disputed, belong to this interval. The discussion itself and all the arguments brought to bear seem to render this solution possible.

The completely different character of the fauna of each, which

led the older geologists to draw their most emphasized line of division between them, presupposes of itself a great interval. The conception I have formed of this interval is such, that I should feel no difficulty in referring strata to it, even to a thickness of 10,000 feet. I will endeavor to explain the reasons for this belief.

In England no break could be more complete, geologically and zoölogically, than that between our lowest Eocene and the chalk upon which it rests, although to the eye but a slightly eroded surface and a few flints separate them. The Eocenes are the result of a long series of local deposits of shallow estuaries and rivers, and the causes which led to their deposition can be traced. The chalk contrasts very strongly, being the deposit of wide ocean without any indication whatever of the proximity of land. We have but a mere fragment left, and its former presence over the larger part of Great Britain and Ireland can only be traced by the flints which have been left behind. We do not yet even know what were the shore lines in any direction of the Cretaceous ocean, for the indications of it in Europe may belong to a later period when part of its bed was being elevated into Præ-eocene land.

No less striking is the completeness of the change which took place in the fauna and flora during the interval. In the Eocenes the progressive change in the Mollusca, notwithstanding the evidently varied physical conditions under which they lived, was so small that they are substantially the same throughout. The changes underwent by them during the whole Cretaceous period is also so small as to be almost entirely of the value now commonly recognized as specific and not generic. When we compare the Cretaceous and Eocene faunas of England together, they seem, however, to have hardly anything in common. In the long interval between them, genera, families and even orders had become extinct, and new types taken their place. We may form some estimate of the lapse of time such changes as these imply, supposing life forms to have been progressively modified, by examining three strata with which I am especially familiar—the Neocomian at Atherfield, the Gault at Folkstone, and the Upper Green sand at Blackdown. These answer the purpose better than any other, because they contain a very similar assemblage of Mollusca, and seem, therefore, to have been deposited by water

of approximately the same depth, although the sea bottom was of different natures, and further there may be gaps of age between them. In all these the genera of Mollusca are the same, and the species marvelously similar, yet when compared together they are found in nearly every case to be slightly modified. Here we have merely specific changes of minute extent, although it would be impossible to estimate the thickness of the deposits from Neocomian to the Upper Green sand, inclusive, comprising also Aptien and Gault, at less than one thousand feet, and the probability is that they far exceed this. This is merely an example, but similar beds, either of Jurassic, Cretaceous or Eocene formations, if contrasted together separately, lead to the same result, provided, of course, that those examined were deposited under like conditions.

Now to compare, for a moment, Cretaceous and Eocene strata. The Gault and the London clay are both massive deposits of clay which seem to have been formed under almost similar conditions and on the same area. The utter dissimilarity of the Mollusca of each, however, is such that the time required to have effected such a change (always admitting progressive modification) would have permitted the accumulation of very many times more sediment than the amount which actually separates them. It may be objected that a part of the difference which we see in these littoral faunæ took place, to an unknown extent, during the deposition of the chalk itself, but this does not seem to have been so to any great degree, since but a slightly modified Gault fauna can be traced through the Gray chalk into the lower White chalk, whilst Ammonites and Belemnites are met with in the highest chalk rocks of England without any mixture of Tertiary forms. There is nothing, therefore, to indicate that any extensive modifications had taken place up to the close of the chalk period in England.

Taking the floras of Cretaceous age in England, whose horizons are absolutely known, we see that they point to an even greater interval than the fauna. Of course I leave out of the question the so-called Upper Cretaceous floras of Europe, whose age, not based upon stratigraphical evidence, is even more a matter of doubt than those of America. The Neocomian flora, from the little we know of it, was similar to that of the Wealden, and the Wealden to the Jurassic; plants would seem, therefore, to have become modified even more slowly than animals. My own

collecting in the Gault, at Folkstone, for twenty years, during the latter part of which I have employed, constantly, a collector, goes far to show that up to that period dicotyledons did not exist, in these latitudes at least. Five new species of cones, branches of conifers with leaves attached, resin and coniferous wood are found, the latter abundantly, but no dicotyledons. I cannot but believe that had dicotyledons existed, some trace of them would by this time, have been found. The same is true of the Gault elsewhere, and especially in Hainault, where a more abundant flora has been brought to light. Neither in Neocomian, Gault, Upper Green sand or chalk, or any Cretaceous deposit in England, has anything leading to the supposition that dicotyledons were then in existence, yet been found. Dicotyledons may have been developing in other areas at this or an earlier period, especially towards the Poles, but from the evidence of British rocks, I should refuse, in the absence of confirmatory stratigraphical evidence, to assign so great an antiquity as that of our chalk to any deposits containing dicotyledons in our latitudes. If clearly older than our Eocene, I should refer them to the great intervening period.

From the almost complete absence of Cretaceous forms in even the lowest European Tertiaries, it seems to have been concluded everywhere, that all rocks containing even a small proportion of Cretaceous types, must be classed as of that age. Isolated protests have been raised, but their value has not been felt. This basis of classification is, in my opinion, entirely erroneous, or at least carried to an excess, for all we know is, that the fauna which existed in Cretaceous seas did not exist in those of the Eocene. How or when it disappeared from these areas we do not know. The extinction, or perhaps partly migration, must, however, have been a natural and gradual one, and we see in many distant countries, California, New Zealand, India, Vancouver's Land, for instance, that late Cretaceous types of fauna lived long after the time of which we have any record of them here, and mingled with a fauna whose characteristics are decidedly Eocene.

For the reasons already advanced I should regard the flora of Dakota, together with those of Nebraska, Vancouver's Land, New Zealand, and many European floras, characterized by an abundance of dicotyledons, as belonging to a vast intermediate period, and should adopt a name suggested by Hector for it—*Cretaceo-Eocene*—in preference to the term Pal-Eocene, used by

Schimper, the latter having been applied by him to true Eocene floras.

With regard to the flora of the Great (1st group of Lesquereux) Lignite, I entertain no doubt whatever that it is of the age of our *Middle Eocene*, and perhaps partly of our Lower Eocene. I am not in a position yet to furnish any list of the fossil plants common to both, but the proportion is very considerable. The only groups I have studied are the ferns. Of a small list from our Middle Eocene, two of the most abundant have been described by Lesquereux from this formation, *Lygodium kaulfussi* Heer (*L. neuropteroides* Lesq.) and *Osmunda*[1] *(?) subcretacea* Saporta (*Gymnogramma haydeni* Lesq.). Mr. Lesquereux has very generously himself assisted in these identifications, and I desire to express to him my thanks for his disinterested aid.

In addition to the similarity of the floras, there is other strong proof that the two formations are approximately contemporaneous. While in our lower Eocene deposits there appears but a small mixture of North American forms, so far as I know at present, in the Middle Eocene they suddenly greatly preponderate, almost to the exclusion of the Australian element previously manifest, and even of what was possibly an older indigenous flora. Judging as well from the Great Lignitic flora as from our own Middle Eocene, it appears evident that at this period land communication somewhere existed between them, which enabled them to mingle to a very great extent; so much so, indeed, that the Pliocene flora of California, lately described by Lesquereux, more resembles our Middle Eocene Bournemouth flora as a whole, not specifically, than any other with which I am acquainted.

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NOTES ON THE FLOWERING OF SAXIFRAGA SARMENTOSA.

BY PROF. J. E. TODD.

ONE often sees in window-gardens the plant popularly called strawberry geranium. As commonly seen, perched in a flower pot on a bracket, it seems to delight in letting down its young plantlets at the ends of thread-like runners, sounding the airy depths for resting places for them. Thus its native instincts appear, though many generations have passed since its ancestors

[1] More properly a new genus.

were learning the advantages of such an accomplishment on the mountains of China.

In flowering it throws up from a rosette of radical leaves a slender naked scape which gradually develops into a cymose panicle. The flowers are of the unique form shown in Figs. 1 and 2. The two lower petals are white, and from two to three times longer than the three upper ones, which are pink, and each marked by two darker spots and one yellow spot, the latter at the base. There are ten stamens arranged in two whorls, those alternate with the petals maturing a day or two earlier than the others. There are two pistils, and on the upper side of their ovaries a triple nectary, *vide* Fig. 3 *e*. This nectary, in its structure and position, suggests the idea that it may be formed of abortive pistils.

The flowers open with surprising regularity. There is first only one at the top of the scape, then when it has passed maturity the first at the ends of the branches open simultaneously; after these have passed their maturity, then the second ones on each branch open, and so on. This regularity is most apparent in the earlier flowering. When the panicle is crowded, unequal distribution of light, heat, etc., seems to confuse and break up this order somewhat. The table subjoined shows these facts. It should be remarked that the position of the plant examined was changed from time to time. There is an irregularity in the flowering of branches VIII and IX, which may be due to their unfavorable position at the very base of the panicle.

Several very curious facts concerning the order of development of the different organs of the flower, were noted.

1. Of the lower petals, which are always unequal, the longer one is always on the side toward the branch which forms the flower next succeeding. As this is on opposite sides in successive flowers, it follows that the longer petals of flowers on any branch of the panicle are towards each other. This relation is shown in Fig. 1.

FIG. 1 —*Saxifraga sarmentosa* (natural size); *a*, pistillate stage; *b*, staminate stage.

2. In both sets of stamens, those on the lower side of the whorl develop first. No. 1 (*vide* Fig. 2) always develops first, then Nos. 2 and 5 before Nos. 3 and 4; and in the second set Nos. 6 and 7 before 8 and 10, and No. 9 always last.

3. Of those stamens in pairs horizontally on the *lower* side of each whorl, the stamen in each pair on the side of the *longer* lower petal develops first. That is, if the longer petal is on the right side (facing as the flower), No. 5 will mature before No. 2, and No. 6 before No. 7, but contrariwise if the larger petal is on the left side. No exceptions were found in thirty-one observations.

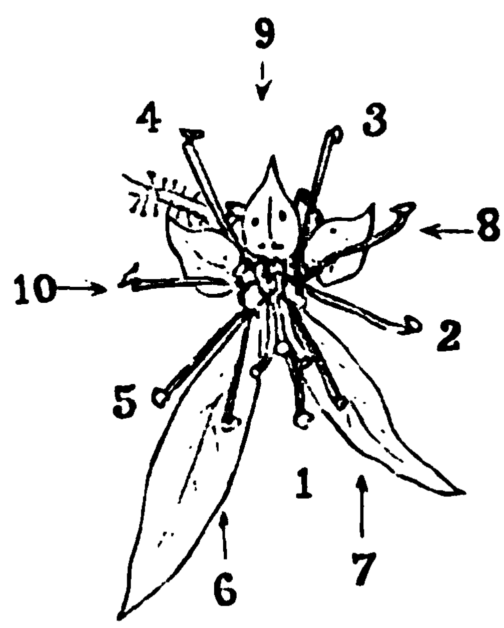

FIG. 2.—*S. sarmentosa* (enlarged); stamen No. 9 in position discharging pollen.

4. Of those stamens in pairs horizontally, on the *upper* side of each whorl, the stamen in each pair on the side of the *shorter* lower petal develops first. If the longer is on the right side, No. 3 matures before No. 4, and 8 before 10, and *vice versa*. In forty-two observations only two exceptions were noticed, and those where No. 8 preceded No. 10 contrary to rule.

In a flower whose longer lower petal is on the right side, the stamens mature in the following order, 1, 5, 2, 3, 4, 6, 7, 8, 10, 9—6 sometimes preceding 4; in one where it is on the left side, 1, 2, 5, 4, 3, 7, 6, 10, 8, 9—7 sometimes preceding 3.

5. The pistils very rarely reach maturity till, No. 9 of the same flower has discharged pollen and withdrawn from position. Sometimes No. 9 becomes entangled with the nectar and is held in the position represented in Fig. 2 longer than the regular time.

6. This brings us to the most remarkable fact of all, viz: *the automatic movements of the stamens.*

The stamens, when immature, stand nearly at right angles with

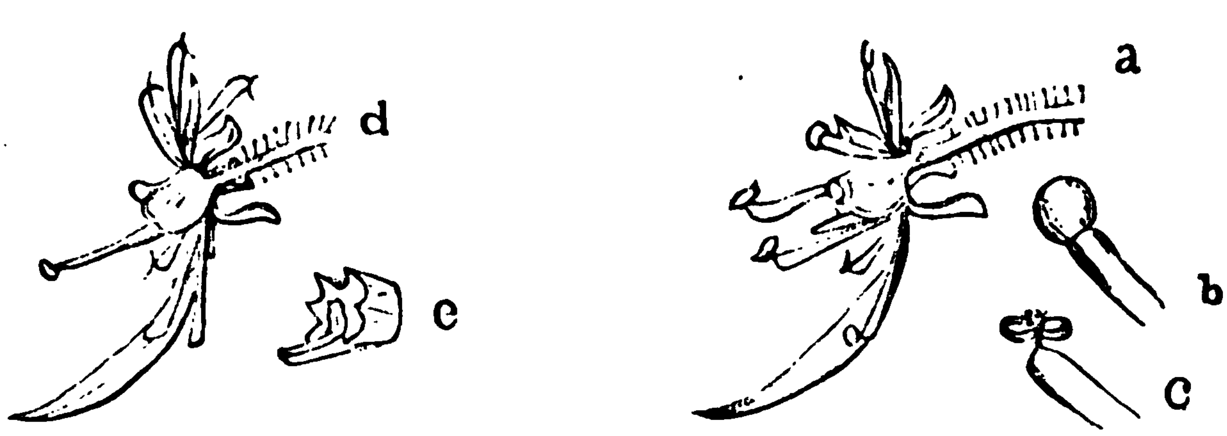

FIG. 3.—Views of the right halves of two flowers of *S. sarmentosa*; *a*, staminate stage; *b*, stamen as before the pollen is discharged; *c*, do, after, *d*, pistillate stage; *e*, nectaries and immature pistils.

the axis of the flower, but when mature they promptly (*i. e.*, probably in 30–130 minutes, according to circumstances) come

into the position represented in Fig. 3 *a*. The exact time has not been noticed in a single case. Sometimes two or three stamens came into position between observations as many hours apart, but in no case was the motion rapid enough to be perceptible. After remaining in position from 2–10 hours they return to their original position, and those alternating with the petals are often thrown back much further, as is shown in Fig. 3 *d*. The stamens on the lower side of the flower, from the nature of the case, move through an angle of about 45°, those on the sides through 90° and those on the upper side about 130°–170°.

7. Another motion is quite as remarkable. The anthers are first in the relation to the filament represented in Fig. 3 *b*, but as they approach maturity they turn up, in every case, and take the position represented in Fig. 3 *c*, which shows also their peculiar dehiscence. After quite a careful examination, no peculiar organs or structures were found to explain either of these movements.

8. The pistils, when mature, bring their stigmas into the same relative position to the axis of the flower, as is shown in Fig. 3 *d*. This is done, however, merely by the lengthening of the styles and the unfolding of the stigmas.

Such an array of mysterious movements and adjustments demands an explanation. Many of them are easily explained by the doctrine of cross-fertilization. The "contrivance" is so obvious that further explanation seems scarcely necessary, but a word or two may make some points clearer. The conspicuous panicle attracts the passing insect, the highly colored petals direct to the nectar, the large petals offer a platform for him to alight and regale himself; but he must pay the price, which, however, is only to have his breast well powdered with pollen in a flower in the staminate stage, which, when he visits another in the pistilate stage will be conveyed exactly to the stigmas. The nectar is protected from insects which do not fly by the glandular hairs bristling all over the peduncles and sepals.

Close-fertilization seems scarcely possible. The only chance seems to be this. In case no insects visit the flower the nectar accumulates and may become so thick that when No. 9 comes into position it is held there until the pistils are mature, as is shown in Fig. 2, then the wind or something else, jarring the plant, may toss the pollen upon the pistils. Cross-fertilization between flowers on the same plant, or even the same branch, is

possible, as may be seen by studying Fig. 1, which represents a real case, or by referring to the table and noting the conditions of the flowers on April 11th, 16th, etc. As was remarked by the writer in a previous article (*vide* this journal, Jan., 1879) there is nothing in the structure of most dichogamous flowers to prevent this, or even to make cross-fertilization between different plants any more probable, except as we postulate some fixed uniform habit in most insects visiting such plants.[1]

In the plant under consideration, however, we find a plan to insure cross-fertilization between flowers on different plants, no matter in what order insects visit the flowers. This may be briefly shown, by referring to the table representing the order of flowering. It will be seen, with the exception of the flowers on the eighth and ninth branches, which are clearly abnormal, and from their position have little part in the general economy of the plant, that each set of flowers first pass four or five days as staminate flowers, then one to three days as pistilate flowers before the next set mature any stamens. Thus the first chance is invariably given to the pollen of another plant. If that is not secured, the pistils are then likely to be fertilized by the pollen of the flowers of the next set upon the same plant. Query: Do other plants with cymose panicles present similar cases? Clearly, therefore, is the conclusion impressed, that the more diverse the circumstances of the flowers the greater the advantage of cross-fertilization. Is cross-fertilization nature's plan for distributing the advantages resulting from a favorable locality to all the individuals of a species, or, on the other hand, neutralizing the evils of a disadvantageous position? Does it render species more uniform?

There remain two or three facts concerning the development of the petals and stamens which demand explanation. We cannot see how their existence is of the least advantage to the plant. Why should one of the lower petals be longer than the other? Or, if we might attribute so much to accident, why should there be regularity about it? May it be that the petal is longer on the side toward the branch because there is a greater amount of nourishment passing on that side to supply the branch, and a proportionate amount is conveyed onward to the flower?

May not a similar relation explain why the stamens on the

[1] Cf. an abstract of a paper by Mr. A. S. Wilson in AM. NAT., Vol. XIII, p. 39.

lower side of a whorl develop first? The lower petals are enlarged to serve the purpose mentioned above. This requires more nourishment to pass through the lower side of the peduncle, and in this nourishment the stamens on that side share.

The earlier development of stamens on opposite sides of horizontal pairs, according as those pairs are above or below, is a very curious fact indeed. To explain it and the whole order in the maturing of the stamens, we will venture the following.

The flowers are quite perfectly pentamerous; the leaves also present the five-ranked arrangement. Remembering the order in which leaves unfold from the bud, and following, for the stamens of the first flower at the top of the panicle, a spiral in the same direction, as that found in the rosette of leaves at its base, we have the numbers in Fig. 4 *a* expressing their order of maturing. Assuming that the increased size of the lower petals is associated with an increase of nourishment in the lower side of the peduncle, and that the stamens are likely to share in this excess of nourishment according to their distance from the lower side of the flower, the numbers in Fig. 4 *b* express the probable order of maturing

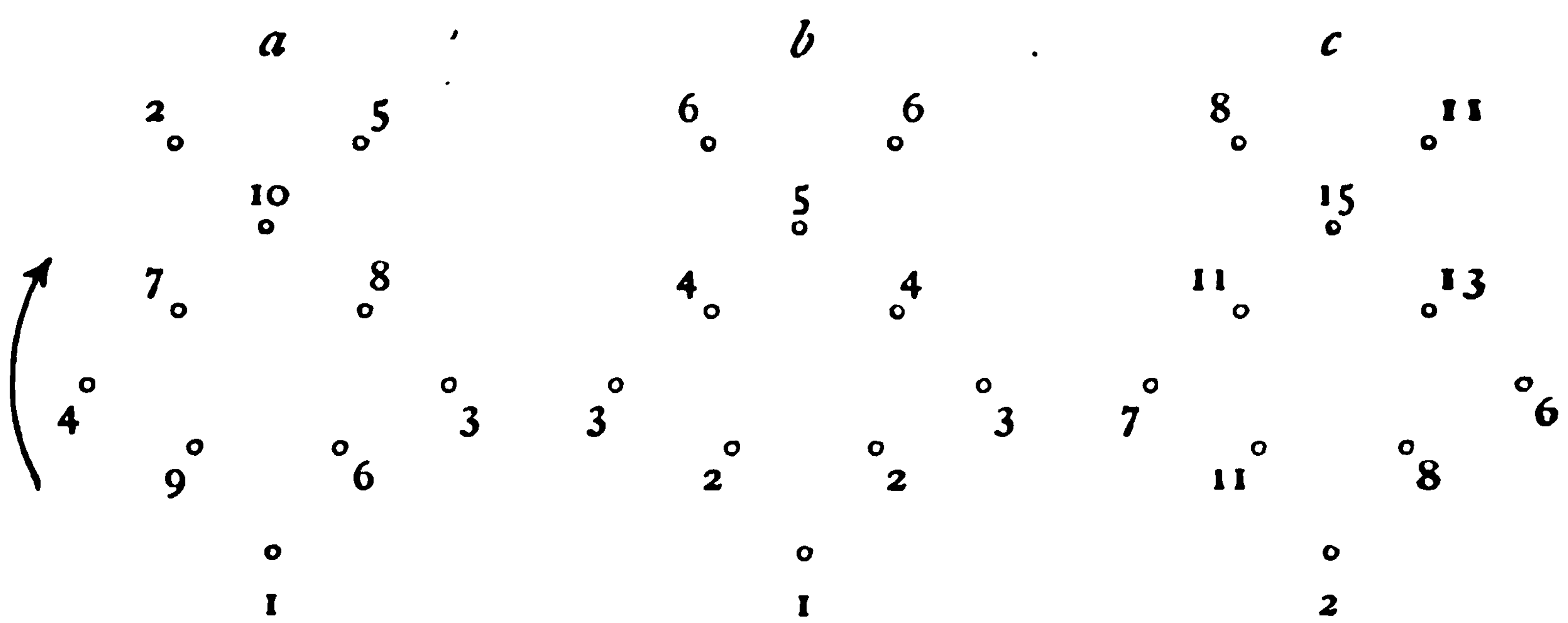

FIG. 4.—A diagram illustrating the order of development of the stamens of *S. sarmentosa*; *a*, order of development derived from phyllotaxy; *b*, order resulting from distance from lower side of flower; *c*, *a* and *b* combined.

if left to this influence alone. If we assume that both influences are acting simultaneously, the sums of these numbers as given in Fig. 4 *c*, will express the order in which the stamens ought to mature when the longer lower petal is on the left side, for such was the case in the particular flower under consideration. Using the numbers for the stamens given in Fig. 2, and referring to Fig. 4 *c*, we find that theoretically they should mature in the following order: 1, 2, 5, (4, 7,) (3, 6, 10,) 8, 9. This corresponds exactly with the order frequently observed. The only discrepancy is

that the numbers joined might theoretically come at once. Our theory seems, therefore, to be proved correct as far as it goes, and sufficiently so to justify another inference, viz: that when the longer petal is on the right side, the parts of the flower are arranged in a right handed spiral; and when it is on the left side the spiral is left handed; and, therefore, that in the inflorescence successive flowers on the same branch have spirals in opposite directions.

But why in opposite directions? And why, too, should stamens imitate leaves in the order of their development? Is it a kind of structural memory, or material instinct? The habits of growth impressed by one set of circumstances where they are advantageous, showing themselves where they clearly have not the same advantage, if any at all?

Where shall we stop? But before leaving the case, let us not overlook the fact that in the later explanations, we have been giving reasons of a very different order from those in the earlier. We then thought it sufficient to show the advantage in a particular arrangement, now we are almost satisfied when we see *how* certain forces, more or less familiar, may have produced the facts under consideration. Neither kind of solution is complete. Let us not be deceived by the ambiguity of the word *why*. It should still be asked *how* the structures so admirably adapted to cross-fertilization have been produced, and we may still ask *why* the facts concerning the stamens exist. Whether they are advantageous and serve a purpose in the economy of nature, or whether they are, as it were, rudimentary phenomena, the incidental effects of laws which have been established for some really important purpose. Such questions we have now no time to follow.

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DESTRUCTION OF OBNOXIOUS INSECTS BY MEANS OF FUNGOID GROWTHS.

BY PROF. A. N. PRENTISS.

ENTOMOLOGISTS have been, for a long time, endeavoring to discover some available means for checking the ravages of obnoxious insects, and of late the possibility of employing fungoid growths for this purpose has been receiving considerable attention. The most important paper which has appeared upon

the subject is a pamphlet by Dr. H. A. Hagen, of Harvard University, in which he advocates the use of the yeast fungus for the purpose in question.[1]

A proposition of this kind, emanating from so high an authority, is worthy of the most careful consideration.

It seems that the possibility of destroying insects by infesting them with fungi from spores artificially sown, attracted the attention of Dr. Bail, of Prussia, more than a dozen years ago. His experiments, however, were not conducted with reference to the point in question, but for the purpose of establishing the identity of certain forms of fungi which had been regarded as distinct. That Dr. Bail's conclusions do not follow from his experiments; for instance, that the house-fly fungus *(Empusa muscæ)* and the yeast fungus *(Saccharomyces cerevisiæ)* are merely different developments of the same species—is an opinion, I think, that every mycologist who has had experience in the growth of microscopic fungi will endorse. This, however, does not affect Dr. Hagen's main proposition, inasmuch as the identity of the fungus is of small importance so long as it proves fatal to insects and its application is practicable. Propositions of a similar nature to that of Dr. Hagen's have been made by other scientists, notably by M. Pasteur some years since, whose investigations upon the silk-worm disease led him to suggest to the French Commission du Phylloxera, the possibility of destroying the insect which had committed such fearful ravages upon the grape-growing industry of France, by its inoculation with some microscopic fungus.

In this country, as long ago as 1874, the same idea was suggested by Dr. John L. LeConte.[2] He recommends that a careful study of the epidemic diseases of insects be made, especially those of a fungoid nature, hoping thereby that some sweeping remedy may be found by which man can rid himself of insect enemies.

Charles H. Peck, State botanist of New York, advanced the same idea in 1876, only, however, applying it to the destruction of obnoxious plants. He says,[3] "On the other hand, those fungi

[1] "Destruction of Obnoxious Insects, Phylloxera, Potato Beetle, Cotton-worm, Colorado Grasshopper and Greenhouse pests, by application of the Yeast Fungus." Cambridge, 1879.

[2] "Proceedings of the American Association for the Advancement of Science," 1874, p. 22.

[3] Twenty-ninth Annual Report on the State Museum of Natural History (1876), p. 30.

that infest noxious weeds and hinder their dissemination and multiplication must be regarded as the friends and allies of man. Thus, the thistle rust, *Trichobasis suaveolens*, an early stage of *Puccinia compositarum*, sometimes attacks the Canada thistle with great virulence, and so impairs its vigor as to prevent the development of the seeds, thereby checking the propagation and spread of this pestilent plant. So, also, the troublesome bur-grass, *Cenchrus tribuloides*, is sometimes infested by a smut fungus, *Ustilago syntherismæ*, which not only prevents the development of the seeds of the grass but also the annoying bur-like involucres. It may yet be found practicable to keep down this grass by the artificial dissemination of the spores of its parasitic fungus."

Among the facts pointing to a favorable issue of the proposed remedy against obnoxious insects, is the well-known fact that many insects living under wholly natural conditions are annually destroyed by fungi. Cook states that about twenty-five species of the genus Torrubia are known to be parasitic on insects.[1]

Mr. Peck, in his Annual Report on the N. Y. Museum of Nat. Hist. for 1878, says, that "the seventeen-year locust, *Cicada septemdecim*, which made its appearance in the Hudson River valley early in the summer, was affected by a fungus. The first specimen of this kind that I saw was taken in New Jersey and sent to me by Rev. R. B. Post. Examination revealed the fact that the Cicadas or 'seventeen-year locusts' in this vicinity were also affected by it. The fungus develops itself in the abdomen of the insect, and consists almost wholly of a mass of pale-yellowish or clay-colored spores, which to the naked eye has the appearance of a lump of clay. The insects attacked by it become sluggish and averse to flight, so that they can easily be taken by hand. After a time some of the posterior rings of the abdomen fall away, revealing the fungus within. Strange as it may seem, the insect may, and sometimes does, live for a time even in this condition. Though it is not killed at once, it is manifestly incapacitated for propagation, and, therefore, the fungus may be regarded as a beneficial one. In Columbia county the disease prevailed to a considerable extent. Along the line of the railroad, between Catskill and Livingston stations, many dead Cicadas were found, not a few of which were filled by the fungoid mass."

[1] "Fungi, their Nature and Uses," p. 218.

Mr. Peck again, in the same report, says, that "While in the Adirondack region, numerous clumps of alders were noticed that had their leaves nearly skeletonized by the larvæ of some unknown insect. The larvæ were nearly black in color and scarcely half an inch long. They were seen in countless numbers feeding upon the leaves and threatening by their numbers, even if but half of them should come to maturity, in another year to completely defoliate the alders of that region. Upon looking under the affected bushes for the pupæ of the insect, in order, if possible, to have the means of obtaining the species, what was my astonishment to find the ground thickly flecked with little white floccose masses of mold, and that each one of these tufts of mold was the downy fungoid shroud of a dead larva from the alders. Not a single living pupa could be found, but there were hundreds of dead and moldy larvæ, killed without doubt by the fungus, which is nature's antidote to an over production of the insect and nature's agency for protecting the alders from utter destruction."

The "pébrine," a disease which appeared in South France nearly thirty years ago and attacked the silk-worms with much virulence, is also a case in point. A popular account is given of this epizoötic in Huxley's Lay Sermons.[1]

This disease appeared in the rearing houses in great violence in 1854, although it had been occasionally seen previous to that date. The name "pébrine" was given to it because of the dark spots which appeared on the bodies of the infested larvæ.

The malady spread from year to year, until in 1858 the amount of silk produced was diminished to one-third of that which had been made previous to 1853. In brief, a microscopic fungus, preying upon the silk-worm and causing its destruction by thousands, prostrated the industries of the city of Lyons, and plunged its working class into idleness and want. What the total loss was, could not be determined, as all classes of industry suffered, but the direct loss was estimated at $250,000,000.

The fact that the insects mentioned by Dr. Hagen exist in great numbers, is most favorable to the rapid spread of any disease that may appear among them, and the remedy proposed, should it work at all, would probably prove powerful, rapid and insidious. The spread of the potato rot, *Peronospora infestans*, over the whole of the British Isles within two years after its intro-

[1] Lay Sermons, pp. 373-375.

duction, is an example of how rapidly and thoroughly spores may permeate any region when all the conditions are favorable to their growth.

In examining the question as proposed by Dr. Hagen, many facts must be taken into account before deciding upon the probable results. It must be remembered that the air is at all times charged with the spores of fungi. Dr. Cunningham found that "spores and other vegetable cells are constantly present in atmospheric dust, and usually occur in considerable numbers; the majority of them are living and capable of growth and development."[1]

Dr. S. M. Babcock, who is determining the chemical changes of cheese during the curing process, finds it impossible to avoid mold in the curd except by heat and anæsthetics (ether and chloroform). He states that the spores *seem* to be in the very milk used in the experiments.

In the Botanical Laboratory, where molds and yeast are cultivated at certain times for experimentation, the air soon becomes charged with spores.

Growing in the same laboratory and rooms directly connected with it, are plants which require constant care lest they be overrun with their several insect pests. No disease appears to have attacked these insects. It may be said that they do not feed upon the yeast, and for this reason escape. It is not necessary that the spores be eaten by the insect in the case of the fly fungus *(Empusa muscæ)*. Huxley says:[2] "It has been ascertained that when one of the spores falls on the body of a fly, it begins to germinate and sends out a process which bores its way through the fly's skin; this having reached the interior cavity of the body, gives off the minute floating corpuscles which are the earliest stages of Empusa. The disease is 'contagious,' because a healthy fly coming in contact with a diseased one from which the spore-bearing filaments protrude, is pretty sure to carry off a spore or two. It is 'infectious,' because the spores become scattered about all sorts of matter in the neighborhood of the slain flies."

In this connection it should be noted that while the insects which infest more or less the plants growing in the laboratory

[1] "Microscopical Examinations of Air," from the "Ninth Annual Report of the Sanitary Commissioner." Calcutta, 1872.

[2] "Lay Sermons, Addresses and Reviews," p. 372.

have not been affected in any way by the fungi or their spores, the plants themselves, in some instances, have been seriously injured. On one occasion, recently, some experiments which had been commenced with much care upon *Drosera rotundifolia*, were brought to a sudden end by a mold which completely overrun and destroyed the plant. That the air of the laboratory should become abundantly charged with spores, would, of course, be expected from the large number of experiments in the growth and propagation of microscopic fungi which at times are being conducted by the members of the classes in mycology. Indeed after a time the spores become so abundant that all apparatus has to be thoroughly cleansed and fumigation by sulphur resorted to in order that the experiments with the fungi themselves should not be defeated.

The abundance of these spores of many kinds, including those of the house-fly fungus, emphasizes the fact that aphides and other plant insects, seem to thrive in the midst of these spores without any diminution of their vigor or power of reproduction.

Although our whole experience in the cultivation of fungi, as might be inferred from the statements already made, as also nearly all observations made upon fungoid growths in general, indicate that the yeast fungus offers little promise of success as a remedy against obnoxious insects, nevertheless the matter has been deemed of sufficient importance to warrant a considerable amount of labor in the way of experimentation for the purpose of arriving, if possible, at some definite facts bearing directly upon the subject. A brief account of the methods and results of this undertaking is here given. All of the experiments here described were made on plants growing in pots in the Botanical Laboratory, or in the adjoining rooms, or in a large conservatory window, where the conditions of light, heat and moisture were favorable to the healthful growth of the plants experimented upon.

In conducting the experiments I have been greatly aided by Instructor W. A. Henry, of the Botanical Department, who has also rendered much assistance in collating information relating to the whole subject.

Experiment No. 1.—A strong plant of strawberry geranium (*Saxifraga sarmentosa*) has been allowed to become infested with green aphides. They are mostly confined to the flower peduncles and young tips of the runners.

May 13.—The plant is thoroughly sprinkled with d[illegible] t by

means of a flat paint brush so that all parts, especially those covered with aphides, are fairly wet. The yeast used is fresh domestic yeast, diluted with two-thirds water. Torulæ are active, as is shown from the fermentation in progress. After being sprinkled the plant is placed by itself on a table and covered by a large funnel-shaped hood, made of thin white paper, slightly open at the bottom to admit air. A cup of actively fermenting yeast is placed at the side of the plant under the hood, so that any germs which may possibly escape from the yeast will be confined to the air immediately surrounding the plant. Some of the older leaves are infested with a number of scale insects.

May 15.—No dead aphides are to be found. Some cast-off skins from molting are seen.

May 18.—Peduncles and tips of runners are loaded with plump aphides. Many cast-off skins. No dead insects are found. The scale insects larger and apparently more numerous.

May 20.—All young parts completely covered with aphides.

June 3.—The plant is obviously injured from attack of aphides and scale insect. Some of the leaves are dead. The plant is out of flower and the peduncles are more or less withered. On these peduncles are a number of dead aphides. These might have starved for want of food, owing to the drying up of the juices of the peduncles. A number of dead aphides are examined under the microscope in a variety of ways, but in no case is there any appearance of Torulæ or other fungoid growths. Numerous live aphides are found on the younger parts of the plant.

Experiment No. 2—May 13.—A small geranium plant (*Pelargonium angulosum* var.), infested with a considerable number of aphides, is sprinkled with domestic yeast (the same as in No. 1), and placed in a window in its ordinary position among other plants not infested.

May 15.—Aphides more scattered but apparently not less in number.

May 18.—Aphides plainly more numerous. Numbers of cast-off skins from molting. Some leaves of geranium with dark-brown spots obviously caused by drops of yeast; other plants of the same kind not treated with yeast show no spots.

June 3.—Aphides numerous and healthy. Quantities of cast-off skins. No dead aphides to be found. Foliage obviously injured by the yeast. Plant plainly enfeebled by the aphides.

[*To be continued.*]

RECENT LITERATURE.

PACKARD'S ZOOLOGY.[1]—In 1876 Dr. Packard published a very convenient text book on comparative embryology, which was the first attempt to present this subject in a complete form for the use of beginners and students. He has followed it with another excellent text book of a wider scope, bearing the title given above. He has succeeded in making this the best text book yet brought out in this country or England, on the complete subject of general zoōlogy. There are many useful books considering special parts of the subject, and invaluable descriptions of the anatomy and embryology of typical animals, which no student or laboratory should be without, but none which treat in the same comprehensive manner the whole subject of zoōlogy, incorporating in it the latest investigations.

In some respects the plan of the book is unique. The author has intended to embrace an account of the anatomy, and in some cases the embryology of a typical and, when possible, common animal of a class, and after a minute description of the type, has sought to familiarize the student with the peculiarities of closely allied or distantly related animals. In his development of this plan and execution of the work, Dr. Packard has admirably succeeded.

The illustrations, taken for the most part from the works of well-known specialists, are well chosen and clearly reproduced. Teachers in the class room will find them very valuable to copy on the blackboard. Those figures published for the first time, of which there are quite a number, are well fitted to accomplish all that was intended. They are, in most cases, designed simply as helps to the young student in his work on the "gross anatomy," and indicate very well the general shape and position of different organs. They will be found of great value to those for whom the book was intended. Advanced students who would carry their studies into special and original lines of research, would naturally consult monographs by specialists. That need of the young naturalist as he matures in his work, has not been overlooked by the author, and a bibliography has been added to the book full enough of standard works to carry such over the threshold of special research. Several of the chapters close with short directions for laboratory work. This departure from the stereotype way of casting text books, seems to us one of the many excellent points in the work. Any one who has had occasion to use some of the best contributions to anatomy and embryology in late years, will recognize the value of an account of the methods by which results are obtained. This account of reagents used and mode of manipulation followed, the Germans

[1] *Zoölogy for Students and General Readers.* By A. S. PACKARD, Jr., M.D., Ph.D. With numerous illustrations. New York, H. Holt & Co. 8vo, pp. 719. $3.00.

call the author's "Tecknik." The work of Dr. Packard is the first attempt in a general text book on zoölogy to give the young student a good tecknik by pointing out the proper mode of manipulation by which the best results can be reached. It would add much to the value of this part of the book if directions even more elaborate were given, and if more attention was given to methods of "section cutting" and staining of tissues.

The few errors which a hypercritical reviewer may find in the book, do not detract from its merits. Several specialists, some of whom are themselves teachers in prominent universities, have read over the manuscript of the chapters on their respective specialties; their names are sufficient guarantees of the value of the work which they have revised. The Cœlenterates have not been as fortunate in this respect as their no more deserving relatives, and a few mistakes have crept in. The separation of the sponges from the Protozoa is well made, as justified by late researches on the anatomy and development of both. The researches of Noschin and Metschnikoff (*Zeit. f. wiss. Zool.*, B. XXIV) seem to show the worthlessness of the name Cœlenterates as indicating structural differences from the Echinoderms. The affinity of the group as pointed out by the elder Agassiz and supported by Alex. Agassiz, is the best yet proposed.

The following corrections, of more or less importance, should be made in the book. They are not of such weight as to condemn a work the general plan of which is so good.

On page 60 the author says, "Budding occurs in the medusa of *Sarsia prolifera*, the only example known of budding in free medusæ." Alex. Agassiz (Proc. Bost. Soc. Nat. Hist., Vol. IX, p. 12) has shown that budding occurs in the free medusa of *Lizzia grata*, also (North American Acalephæ, p. 163) in *Dysmorphosa fulgurans* and in *Hybocodon prolifer*. These medusæ are all found in New England waters. Many similar cases have been described in Mediterranean genera.

On page 65 it is stated that ninety species of true "Discophora" are known from the eastern coast of the United States. No one has enumerated more than a dozen forms from this locality, and many species which have been described, as for instance two of the three species of Cyanea, are not "bonæ species."

For the help of those who would work in the prolific field of the study of our jelly fishes, let me add partly as a correction of what is said on page 63 about the "Trachymedusæ," that their most common representative in our waters is not, as in the Mediterranean, the genus Cunina, nor is this Cunina confined to Charleston, S. C. Our most abundant Trachynemida is *Trachynema digitalis* A. Ag., which can at times be collected by hundreds in a single excursion in Narragansett bay. Cunina is also found there but, as in Charleston harbor, is not so numerous.

There is much obscurity on page 65 in the description of the

growth of the "tentacles" (?) in Aurelia to form the "mouth opening," and the statement of the position of the eyes. The obscurity comes from the use of the word fringed as applied to the edges of the "mouth opening" and the margin of the disk. The sense organs of Aurelia have no connection with the walls of the "mouth opening." I find no authority for the statement that the "square mouth opening" in *Aurelia flavidula* is formed by the union of four "tentacles." I have also studied the live ephyra of Cyanea and Aurelia, and find no such method of formation of the mouth in these genera.

It is to be regretted that the splendid memoirs of Eimer and the Hertwigs could not have been quoted at greater length. Much, of course, had to be omitted to prevent the book assuming undue proportions The discovery by the latter that the otolith of the Trachynemidæ is endodermic, while that of the free medusa of the Campanularians is ectodermic, is one of their most important discoveries, and should be mentioned.

The statement on page 62 by which the "Discophora" are made to differ from the Hydromedusæ "in developing directly from eggs," and that on page 68 that *Pelagia* ("*campanella*"?) *cyanella* does not undergo a metamorphosis but "grows directly from the eggs" would leave one unfamiliar with the embryology of these animals in doubt as to what is meant by a direct development from the egg. Pelagia differs from Aurelia in that it never passes through an attached strobila stage.

In view of the elasticity of the word homology in recent times, one is not surprised to find the foot of a mollusk compared to the under lip of a worm (?), or *vice versa* (p. 12). It is doubtful whether such a comparison would be accepted by all naturalists, and questionable whether it should be introduced as an illustration of the term in a text book. The term homology, like many others (polymorphism, individual, &c.) is yet to be accurately defined in a manner acceptable to all. At present there is no better illustration of the term than the old comparison of the wing of the bird and the arm of man.—*J. W. F.*

STUDIES FROM THE MORPHOLOGICAL LABORATORY IN THE UNIVERSITY OF CAMBRIDGE.[1]—This thick brochure is mostly taken up with embryological papers which have appeared during the past year in the Quarterly Journal of Microscopical Science and the Proceedings of the Cambridge Philosophical Society. The papers relate mostly to the special points in the development of the Vertebrates. The first paper relates to the existence of a head-kidney in the embryo chick together with some points in the development of the Müllerian duct. In this paper Messrs. Balfour and Sedgwick record the existence of certain structures in the embryo chick, which event-

[1]Edited by F. M. Balfour, M.A., F. R. S., Williams and Norgate, 1880. 8° pp. 109. 10 plates.

ually become in part the abdominal opening of the Müllerian duct, and which correspond with the head-kidney, or "vorniere" of German authors; they also conclude that the Müllerian duct does not develop entirely independently of the Wolffian duct; and finally the authors discuss certain rectifications in the views of the homologies of the parts of the excretory system in birds, necessitated by the results of their investigations.

In the second paper Mr. Balfour traces the early development of the lizards, and discusses the nature and relations of the primitive streak. He also shows in the third paper that the nervous cords of Peripatus are minutely ganglionated, and are not simple nervous threads as heretofore supposed.

Messrs. Scott and Osborn's paper on the early development of the common newt of England we have elsewhere noticed. The fifth paper is by Mr. Adam Sedgwick, on the development of the kidney in its relation to the Wolffian body in the chick. Although considerable good work has been done on the embryology of the spiders, Mr. Balfour has worked out additional points of much interest in his paper on the development of the Araneina. Among these he has proved that the supra-œsophageal ganglion of the adult is the result of the fusion of what in the embryo are two separate ganglia, and he thus effectually settles the question as to whether the first pair of appendages, the mandibles, represent the antennæ of the insects and myriopods, since he demonstrates that the nerves to these appendages are sent from what is originally the second pair of nervous ganglia, thus showing that the antennæ are morphologically as well as functionally absent.

The view at one time prevalent, that the Arachnida are as nearly related to the Crustacea as to the insect, is not sustained by the facts brought out by Mr. Balfour, who states that "such differences as there are between insects and Arachnida sink into insignificance compared with the immense differences in the origin of the mesoblast between either group, and that in the Isopoda, or still more the Malacostraca and most Crustacea." Farther on he says, "In the formation of the alimentary tract, again, the differences between the Crustacea and Tracheata are equally marked, and the Arachnida agree with the Tracheata." This is confirmatory of the view taught by Leuckart, Agassiz, and insisted upon by others, that the Arachnida and insects (Hexapoda) as well as myriopods belong to a class, Insecta or Tracheata, as opposed to the Crustacea or gill-bearing Arthropods, which may, with Gegenbaur, be called Branchiata.

The seventh and last paper, by Mr. Adam Sedgwick, treats of the development of the structure known as the "glomerulus of the head-kidney" in the chick. This has been found to be "nothing more than a series of glomeruli of primary Malphigian

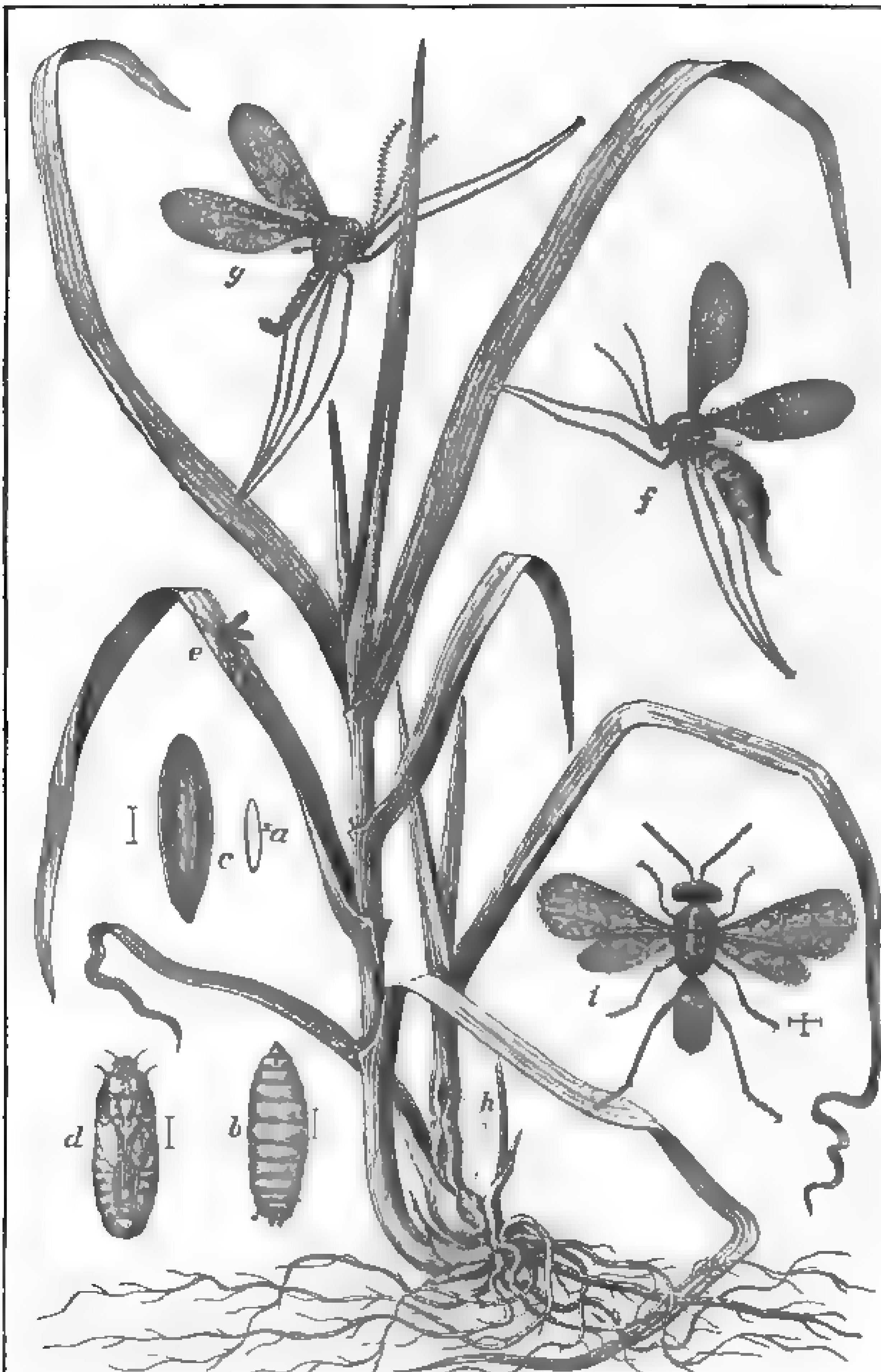
bodies projecting through the wide openings of the segmental tubes into the body-cavity."

THE HESSIAN FLY.[1]—The object of this and several of the Bulletins issued by the Entomological Commission is not so much to show evidence of special and new field studies or for the display of entomological learning, as to set forth well-known facts regarding the more injurious insects and the best means of combating them, and to place the results in the hands of those most interested, *i. e.*, the farmers. The Bulletins so far issued by the Department of the Interior, have rapidly gone out of print, and fresh editions furnished either by the Department or by Congress. It was contemplated to issue others, and this could have been done, with little expense to the country and without detriment to the objects for which the Entomological Commission was working, *i. e.*, the thorough investigation of the locust plague and the depredations of the cotton-worm; but such a design was considered unlawful and nefarious by the Commissioner of Agriculture, and every effort was made by that enlightened official, aided by his entomologist, to not only stop the issue of such bulletins as the one before us, but to extinguish the Commission outright. While Congress voted larger appropriations than ever before to the Commission, the immediate result of Gen. Le Duc's labors was to restrict the labors of the Commission for the coming year to the locust and cotton-worm. All this is directly in the line pursued by some of our former agricultural commissioners, and evinces the wisdom of political appointments, *i. e.*, of ex-judges and railroad contractors, for a position which could be made one of great importance and usefulness if worthily filled.

The plate[2] reproduced gives an idea of the Hessian fly and its transformations, and its chief parasite, the *Semiotellus destructor*. Not much, though some new matter has been added to what was previously known as to the habits of this insect or the remedies against its attacks, but the chronological table of years of abundance of the Hessian fly, may prove of interest as well as the bibliographical list.

[1] *Department of the Interior. U. S. Entomological Commission. Bulletin No. 4. The Hessian Fly, its Ravages, Habits, Enemies and means of preventing its increase.* By A. S. PACKARD, Jr. Washington, May 20, 1880. 8vo, pp. 43.

[2] EXPLANATION OF THE PLATE.—A healthy stalk of wheat on the left, the one on the right dwarfed and the lower leaves beginning to wither and turn yellow; the stem swollen at three places near the ground where the flaxseed (*h*) are situated, between the stem and sheathing base of the leaf. *a*, egg of the Hessian fly (greatly enlarged, as are all the figures except *e* and *h*). *b*, the larva, enlarged, the line by the side, in this and other figures, showing the natural length. *c*, the flaxseed, puparium or pupa case *d*, the pupa or chrysalis. *e*, the Hessian fly, natural size, laying its eggs in the creases of the leaf. *f*, female Hessian fly, much enlarged. *g*, male Hessian fly, much enlarged. *h*, flaxseed between the leaves and stalk. *i*, chalcid or ichneumon parasite of the Hessian fly, male, enlarged.



THE HESSIAN FLY, AND ITS TRANSFORMATIONS.

A New German Geographical Journal.[1]—This is a new periodical designed to present, from time to time, a brief but excellent digest of the progress of geographical science, with its literature. It is printed in large octavo form, with clean type and on excellent paper, so that it presents an excellent appearance. There are no less than twelve collaborators from all parts of Germany and Switzerland, representing some of the best known geographers in Europe. In the third number there is a long account of the history of the Hayden Geological and Geographical Survey of the Territories, with the entire catalogue of publications printed in detail.

Favre's Geology of the Canton of Geneva.[2]—This important work of M. Favre may be regarded as an exhaustive monograph of the geological, archæological and agricultural resources of the Canton of Geneva, Switzerland, and therefore local in its character. Local treatises of this kind are not uncommon in Europe; many of them have been written of limited areas in France, and it would be an advantage if studies of this kind were made of the more interesting and complicated districts in our own country.

The work commences with a preface and a preliminary chapter defining its object to be mainly the application of geology to agriculture. A chapter follows describing in a brief manner the elements of the science, and then the principal formations within the limits of the Canton, are noted in detail. The Quaternary and the present superficial formations are described in great detail and in a masterly manner. The portion treating of the glacial period is of great interest, and is well worthy of careful study.

Numerous analyses of rocks and soils are given and a considerable portion of the book is devoted to a minute study of the rocks and minerals of the canton. At the end of Tome II are eight large folded plates of geological and archæological illustrations [illegible]. Accompanying the work are four maps [illegible] [illegible] which the geology is shown in great detail. The entire work is a contribution to science worthy of the [illegible] author of "Recherches Géologiques [illegible] de la Savoie, du Piémont et de la Suisse voisines du Mont Blanc."

[illegible]

[illegible]

[illegible]

West Tennessee: its Resources and Advantages. By J. B. Killebrew. 8vo, pp. 93, 1880. From the author.

On the Physical Structure and Hypsometry of the Catskill Mountain region. By Arnold Guyot. (From Amer. Jour. Sci., Vol. XIX, June, 1880.) 8vo, pp. 22, maps 2. From the author.

Geological and Natural History Survey of North Carolina. Part III—Botany. By M. A. Curtis. 8vo, pp. 156, 1867.

The Felsites and their Associated Rocks north of Boston. (From Proc. Boston Soc. Nat. Hist., Vol. XX, Jan. 21, 1880.) By J. S. Diller. 8vo, pp. 12, 1880. From the author.

Proceedings of the Academy of Natural Sciences of Philadelphia. 8vo, pp. 152, 10 pls. Pt. 1, 1880. From the academy.

Catalogue of North American Musci. Arranged by Eugene A. Rau and A. B. Hervey. 8vo, pp. 52, 1880. From the authors.

Korte Bidrag til nordisk Ichthyographi. III Gronlands og Islands Lycoder. Med Bemærkninger om andre nordiske Arter. (Aftryk af Vidensk. Meddel. fra den naturhist. Foren. i Kbhvn. 1879-1880.) By Dr. Chr. Lütken. 8vo, pp. 26, 1880. From the author.

Le Globe Lenox de 1511, Traduit de l'anglais par Gabriel Gravier. 8vo, pp. 26, 1880 From the author.

Découverte d'un Squelette entier de Rytiodus dans le Falun Aquitanien. (Ext. des Actes de la Société Linnéenne de Bordeaux.) Par M. E. Dellortrie. 4to, pp. 16, pls. 4, 1880. From the author.

The Orthonectida, a new class of the Phylum of the Worms. (From Quart. Journ. Micros. Sci.) By Alfred Giard. 8vo, pp. 15, pl. 1, 1880. From the author.

Zur Anatomie und Physiologie des Nervensystems der Nemertinen. Von A. A. W. Hubrecht. 4to, pp. 47, pls. 4, 1880. From the author.

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GENERAL NOTES.

BOTANY.

Changes in Plant Life on the San Francisco Peninsula.[1]—We are not very apt to notice changes that gradually and progressively prepare themselves in our surroundings. We have no room in our journals for facts of every-day occurrence, and at the same time these gradual changes offer more analogies to the great secular changes that have preceded the present state of our globe, and give more material for the study of evolutions than all floods, earthquakes and other cataclysms.

All vegetation of our earth is subject to secular changes, and it is not necessary to go to the fossil plants, imbedded in coal, to find ample proofs for this axiom. The bogs of Northern Europe, the lacustrine dwellings of the Alpine regions, show in different strata the remainders of different forest trees; and in the Atlantic States many acute observers have noticed that the birch gradually supersedes the conifers.

Such a process of change, of course, is accelerated if to the secular process of change is added the powerful agent of human

[1] The following essay, which will be of interest to all botanists and observers of plant growth generally, was read at the meeting of the Academy of Sciences, Feb. 2d, by Dr. Herman Behr, of San Francisco, and appeared in the *Rural Press*.

activity. I have had the good fortune to witness this process in two different quarters of the globe; in Australia and in California.

The neighborhood of San Francisco and its flora in the year 1850 was not entirely in its natural state, but still the three original types of landscape that constituted the region could well be distinguished. The sand dunes and hills were covered by a dense chapparal of live oak (*Quercus agrifolia*), *Ceanothus thyrsiflora*, and on northern well-moistened declivities by buckeye trees (*Æsculus californica*). In some localities a wild cherry (*Prunus ilicifolia*) entered this combination, but was in growth and foliage so little different from the other components that it easily escaped notice.

This whole region grew very little grass, a fern (*Pteris aquilina*) forming a kind of a rough and rather transparent turf. With the exception of a *Scirpus*, even on marshy places, no Cyperaceous plant was growing. *Achillea millefolium*, *Baccharis*, *Solidago*, *Scrophularia* and [illegible] distributed in tufts, varied the otherwise naked ground. The depressions of this formation frequently contained marshes with a shrubby vegetation of currant bushes ([illegible]) and gooseberries ([illegible]) and a herbaceous vegetation of [illegible], *Baccharis* and [illegible].

This character of vegetation reached almost without modification, up to the Mission Dolores, where grassy plains and hills containing arborescent growths only in their ravines, took its place. [illegible]

ent species of *Rumex*, *Polygonum*, and three gigantic species of *Aspidium* covered the black and yielding ground.

After having penetrated this belt, you would enter a boggy prairie, in which stripes of the above-mentioned arborescent vegetation indicated the more elevated points and ridges. The vegetation of the prairie itself was a most anomalous one, considering the latitude and the merely nominal elevation above the level of the sea. It was a speck of the Arctic flora. Out of a mossy surface rose the slender culmi of a *Festuca* mixed with *Carex* and *Eriophorum*. The characteristic *Menyanthes trifoliata* showed everywhere its feathery racemes; at present, when you wish to see them, you have to go to Alaska, or to very considerable mountain elevations. Besides these was growing a *Habenaria* and the *Epipactis gigantea*, two orchideous plants. *Angelica*, *Heracleum*, *Œnanthe*, *Hydrocotyle* and *Nuphar* represented a vegetation which can be studied still in some localities of this peninsula, but not in the vicinity of the city. Wherever the moisture formed a surface, it was immediately covered by the graceful *Azolla caroliniana*, a *Bidens* and the *Arenaria* above mentioned that has not yet been found again. Now the first-mentioned type of vegetation, the chapparal, exists still in some fragments in the Presidio reservation; the second, that of the pasture land, is to be met with still, wherever the distance from the city is considerable enough to protect native vegetation; but the third type has entirely disappeared.

We now come to the causes. It is not only the quick growth of the city, the sudden change of grade, etc., that have disturbed the original equilibrium in nature, for there still exist lonely, neglected places enough in the immense circumference of the city, where an original vegetation could have remained undisturbed, and where it was protected even against the attacks of domestic animals.

By comparing the present flora of the surroundings, we shall easily recognize one of the most powerful agents in the destruction of original vegetation. At present the three original types of landscape are no more distinguishable. The improvements of a growing city have brought all to the same level. The original arborescents have been cut down partly for fuel, partly to make room for houses. Horticulture has replaced them by the conifers of our Sierra and the evergreens of Australia.

The vegetation of the peninsula is at present more Australian than Californian, and if it was not for the beauty of our sequoias, pines and firs of our mountains, scarcely any California tree would have found admission.

Parallel with this artificial immigration of Australian arborescents, goes an herbaceous immigration from Europe and Africa. Our original vegetation has very little power of resistance. Its very variation is a proof of a certain want of vitality, for any

more vigorous organization, by superseding the weaker ones, would have produced originally the monotony developed at present by the immigration of foreign plants.

First of all I mention *Silybum marianum*, a native of the Mediterranean region, observed by me the first time in 1854 in California, in 1848 in South Australia. Wherever it gets a hold of the soil all native vegetation disappears. California is not the only land invested by this thistle. I have witnessed the same invasion in South Australia, and have read the statement of my former teacher, Prof. Burmeister, at present in Buenos Ayres, that the same thistle protects, through the time of its vegetation, the settlers against inroads of the Pampas Indians, as even these wild horsemen cannot cross the immense thickets formed by the same species of thistle. The influence of this weed is not confined to the neighborhood of San Francisco, and it is chiefly the miniature forests of lupines that suffer from its invasion.

Another weed, *Cotula coronopifolia*, does the same work in moist ground that is begun by Silybum in the more arid tracts of soil. The plant, a native of Southern Africa, was observed for the first time by me in 1854. I also have witnessed its invasion of South Australia, and I recollect very well the single specimen I found near Adelaide in 1845. It is well known in Mediterranean Europe, but as to the date of its invasion, I only know that it was common there at the same time when I found the first specimen in Australia. This weed has transformed the varied aquatic vegetation of the different places invested by itself into one monotonous green mass with yellow buttons. Our graceful water fern, *Azolla*, that formerly ornamented abundantly our creeks by its floating turf, is scarcely to be found any more.

Now, both of these plants which could be called "the coming plants," are Syngenesists or Compositæ. The Compositæ themselves are characteristic of the most modern flora, for in a fossilized state they are only found in the most modern formations; in fact, the only fossilized Compositæ of which I know, were products of a river that fossilized everything thrown into it. Now it appears that in the fight for existence the junior sons of creation have a decided advantage, and this accounts for the otherwise inexplicable circumstance that the variety of organisms decreases so perceptibly when we enter the realms of *Gymnosperms*, vascular *Cryptogams*, and all those forms of organic life that existed in the early periods of the earth.

BOTANICAL NOTES.—In the *Bulletin* of the Torrey Botanical Club, which, by the way, now appears regularly each month, and with a neat cover, Mr. G. E. Davenport describes and figures in an excellent plate a new fern (*Notholæna grayi*) from Southeastern Arizona.——*Grevillea* for June contains a thoughtful essay on Peziza, by M. C. Cooke.——The *Journal of Botany* for May and June continues to review the British Characeæ, and the bot-

any of the British Polar Expedition for 1875–1876.——Dr. Engler, of Kiel, has published the first part of an essay on the evolution of the vegetable kingdom since the Tertiary period, under the title, "Versuch einer Entwicklungsgeschichte der Pflanzenwelt." It relates to the extra-tropical regions of the Northern hemisphere.——Dr. H. Müller contributes to *Kosmos* an interesting critique of Gaston Bonnier's essay on the nectaries of flowers which was written in opposition to recent doctrines of the evolution of flowers.——Messrs. Sereno Watson and C. S. Sargent are botanizing in Northern California and Western Oregon this summer, while Mr. Vasey, a son of Dr. George Vasey, is studying the trees of Southern California for the Forestry Report of the tenth census. Mr. E. L. Greene is herborizing in Southern California, Arizona, and New Mexico. We have two interesting papers from him which have been crowded out unfortunately for want of space.

ZOÖLOGY.[1]

TARDIGRADES AND EGGS.—Having found several specimens of Tardigrades during the past month, I have been fortunate enough to confirm what has been observed in Europe. in regard to their peculiar manner of depositing their eggs. Among them was one which contained within the body, as nearly as I could determine, six spherical masses, which, when examined with higher power, appeared to be collections of eggs. It was in the act of molting, the old skin having slipped back so far as to set free the three

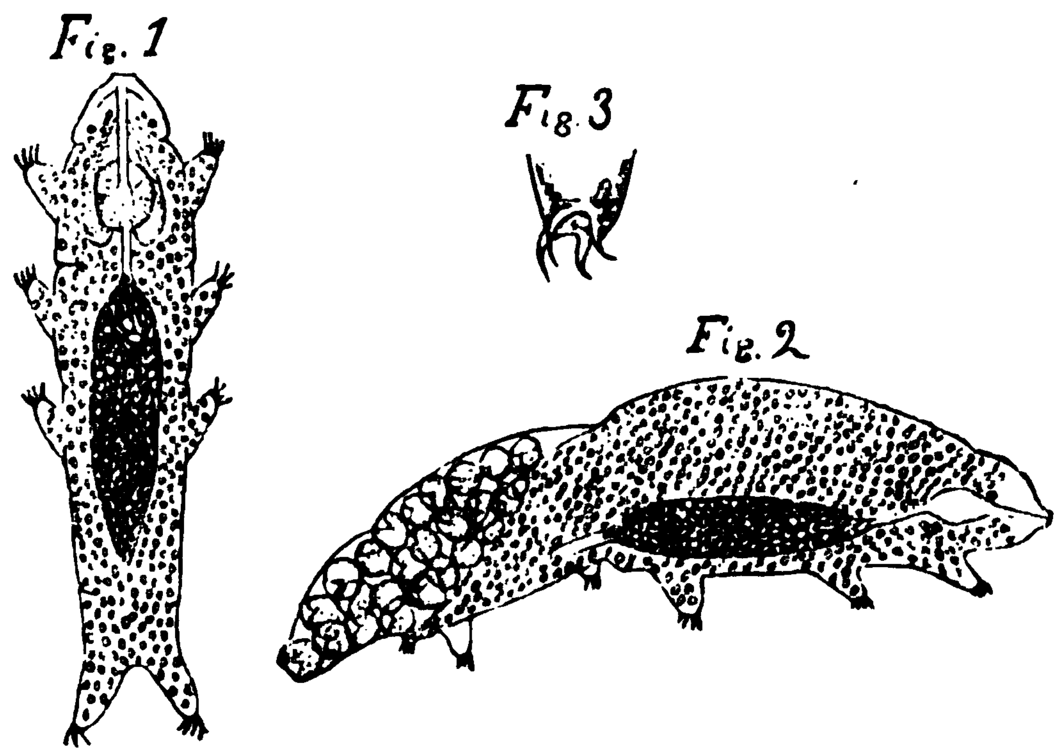


FIG. 1—Normal individual seen from above. FIG. 2.—Individual with egg sack attached. The embryos can be seen within the eggs. FIG. 3.—Enlarged view of foot.

anterior pairs of limbs, while the posterior pair was plainly seen moving within. The skin was empty with the exception of a

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

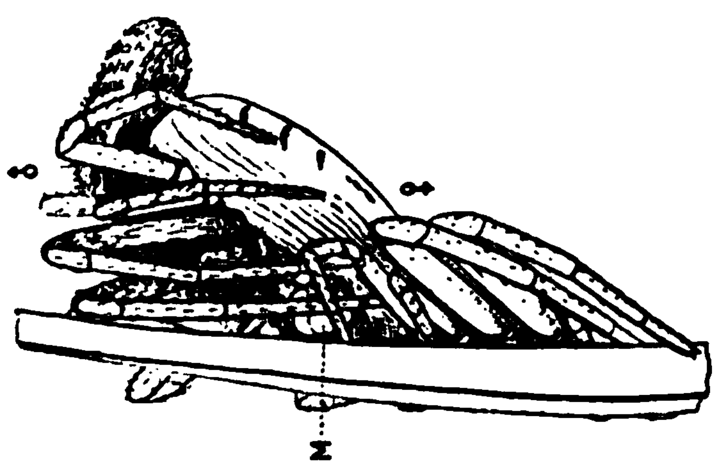
little excrementitious matter. This specimen was lost, but I shortly after found another with the old skin hanging to the body in the same position, but in this case filled with eggs. This one I succeeded in mounting in carbolated water, and so preserved it for future reference. In the normal state these creatures measure about .016 inch in length, but when gravid, or after depositing the eggs in the sack, they are much larger. My specimens were obtained from the sediment in a small aquarium in my sitting room, which contains a few native plants and fishes, and has about an inch of sand in the bottom, which was taken from the river bed last fall. The aquarium swarms with Protozoans, and I have thus far found seventeen Tardigrades, and there are probably many more. The genus I suppose to be Macrobiotus, but do not know that it has a specific name. It is the same that was found by Prof. Bessey in this place several years ago. I send drawings for identification.—*F. E. L. Beal.*

An Abnormal Foot in Amblystoma.—In a specimen of *Amblystoma punctatum* Baird, which I found in Williamstown, Mass., the second or largest toe of the right hind foot presented an unusual abnormality, being bifid at the tip. The osseous skeleton showed the same peculiarity, there being two terminal phalanges articulating with the penultimate one.—*J. S. Kingsley.*

Notes on Myriopods.—I have recently found several species of Myriopoda in Williamstown, which are of interest from the fact that their known localities are very few. Among these are *Pauropus huxleyi* Lubbock, *Eurypauropus spinosus* Ryder, and *Trichopetalum lunatum* Harger. *Pauropus huxleyi*, an English species, has heretofore been only reported from Fairmount Park by Mr. Ryder, which also was the only known locality of *Eurypauropus*. *Trichopetalum* has been found in New Haven and in Philadelphia. The locality where the specimens were found was on "Stone Hill," a limestone elevation, and with them were associated large numbers of *Campodea staphylinus* Westwood. I might also state that I have found here *Helix asteriscus* Morse, it being its first occurrence in Massachusetts.—*J. S. Kingsley.*

Second Flight of Dragon-flies.—I have now to report that last evening (May 24th), on the top of West Hill, in Melrose, I witnessed what to all appearance was a movement precisely like that of last year (see this journal, Vol. xiv, p. 132). The flies were moving over the hill in a business-like fashion, all going in the same direction, from one to six being in sight at once. I watched them for nearly half an hour and they were still passing when I came away. Nobody could see them, I think, without being convinced that they were moved by a common impulse, and for myself, I can hardly doubt that such migrations will be found to be things of regular occurrence. What their occasion and design are I am not entomologist enough even to guess. I should be glad to be enlightened.—*Bradford Torrey.*

BREEDING HABITS OF SPIDERS.—On the afternoon of the fifth of June we were lying on the ground in a dry pasture looking among the short grass, when we noticed a pair of crab spiders, *Xysticus*, under a slanting grass leaf. The female stood head downward holding on by a few threads across the leaf (see figure). Her abdomen was turned a little outward and the male, when we first noticed him was on her left side with his left feet on her abdomen and his right on the grass leaf.



He stood there for a few minutes, now and then working his palpi up and down, then ran up over the female several times and settled himself in the position in the figure over the end of her abdomen with his head just behind her epigynum. After a few moments when he appeared to have his palpus in use, we pushed away the surrounding grass and broke off the leaf on which the spiders were, without disturbing them in the least and found the left palpus in the epigynum with the spinal muscle M inflated. The size of this muscle varied continually, swelling out to its full extent in a sausage shape, and then slowly contracting. We watched him for ten minutes during which he removed his palpus once and inserted the same once again. We then put grass and all into a bottle without disturbing the spiders, but when we looked at them again on reaching home they had separated.—*J. H. Emerton.*

NOTES ON NEW AND RARE FISHES OF THE PACIFIC COAST.—It was until recently currently believed that very few additional species would be found upon the Pacific coast of the United States. The publication of descriptions of three new flat-fishes and a scomberoid form, in 1879, threw some little doubt upon this idea, and the discoveries since made, both by Prof. S. Jordan and by the writer, will, when the results are published, prove beyond a doubt that the Pacific icthyological fauna is far richer than it was supposed to be, and probably richer than the Atlantic.

The Pacific is *the* ocean of the world—the main body of its waters are collected in its vast expanse, and it is only natural to suppose that when men of the more advanced civilizations have searched its shores and its depths as thoroughly as they have searched those of the smaller Atlantic, it will be found that its fauna is rich in proportion to its larger dimensions. If we confine our attention solely to the west coast of North America, we shall find that several groups are peculiar to the region, or are at most represented only by scattered species elsewhere; wh others that are tolerably well represented in the Atlantic ha headquarters here.

The family *Scorpænidæ*, consisting of the genera *Scorpæn*

Sebastes, and their allies, mailed-cheeked scaly fishes, with perfect ventrals, short anal, and first dorsal more developed than the second, has its headquarters upon this coast.

When Dr. W. O. Ayres, in the early days of the California Academy of Sciences, about eighteen years ago, added four additional species to the already known eight or nine described by himself or by Dr. Girard, the announcement was received with doubt.

The writer, resident in San Francisco during the last six years, quickly identified all the described species but one, nor was it long before he perceived several types which differed somewhat from any of them. As, however, he was dependent for comparison upon isolated examples brought to the local museum, and upon the supply of the market, he was unable to thoroughly convince himself whether the three or four varieties of color, accompanied as they were by only slight differences in the form and prominence of the spines of the head, were really species, or only color varieties. But this question is now fully settled by Prof. D. S. Jordan, who, commencing at San Diego, and working northwards to San Francisco, everywhere with abundant means of comparison, has proved that not only three or four, but eight or nine constant and specifically distinct types of this tribe occur, in addition to those before described; so that more than twenty species are now (March 14, 1880) known, and it is not unlikely that the list may be still further increased when Prof. Jordan and his comrade Mr. Gilbert have searched the coast northward to Puget Sound. The number of flat-fishes (Pleuronectidæ) now known to be found between San Diego and Puget Sound exceeds that known on the Atlantic coast of the United States. In my "Review of the Pleuronectidæ of San Francisco" (Proc. U. S. Nat. Mus., 1879), I enumerate thirteen species, three of them new to science. To these must be added a true sole, the first found upon the coast, discovered by Prof. Jordan at San Diego; a flounder allied to Hippoglossoides, but forming the type of a new genus, found by the same ichthyologist at Wilmington and Santa Barbara, and a species of Platysomatichthys (Bleeker), a stray specimen of which found its way into the market of San Francisco. Add to these the more northern *Pleuronectes franklinii*, and we have a total of seventeen species, without counting two unidentified species described by Pallas, a total which, in the light of recent discoveries, must not be accepted as final, since the coast from San Francisco northward may yield new forms to the hard-working explorers of the United States Fish Commission. The specimens of the Platysomatichthys found were evidently the young of a larger form, and Prof. Jordan confidently expects to find more and larger specimens as he proceeds northward.

The conclusion arrived at by the writer that the species re-described by himself as *Pleuronichthys cœnosus* is the *Pleuronectes*

quadrituberculatus of Pallas, is endorsed by Prof. Jordan; but as numerous specimens found south of San Francisco are devoid of the tubercles upon the cheeks, the latter suspects that there may be two species.

The form described by me in the paper before mentioned as *Lepidopsetta umbrosa* (Girard) Gill, turns out to be a new species; but as the *Platichthys umbrosus* of Girard is, as stated by Dr. Gill, synonymous with the *Pleuronectes bilineatas* of Dr. Ayres, this does not increase the number of species in the group. For this species the specific name *isolepis* is proposed, on account of the uniform structure of the scales—a character by which it may at once be distinguished from its nearest ally, *Lepidopsetta (Pleuronectes) bilineata.* Other characters are, its regularly oval form, small eyes, and the comparatively low arch formed on the pectoral region by the lateral line. In general appearance it closely resembles small specimens of *Psettichthys melanostictus*, and is confounded with that species by the dealers, who fail to notice its smaller mouth, rougher scales, and more oval form.

The curious family of small mailed fishes, known as Agonidæ, has now so many known representatives here that it becomes probable that its headquarters are on this coast. To the already known *Agonus acipenserinus* and other sub-arctic forms, Dr. Steindachner, in 1878, added the two new species, one of them the singular Siphonagonus, and since that date three additional species have been found and their descriptions forwarded for publication.

These are two species of Agonus, one of which was first noticed by Prof. Jordan, and the other by myself, and the third a species of Dr. Gill's genus Brachyopsis, described by the writer from numerous specimens obtained in Drake's bay, near San Francisco.

The family of viviparous perch (Embiotocidæ) has long been known as one of the peculiar types of our coast, and the already tolerably numerous species included in it have been reinforced by Prof. Jordan by the addition of three more. One of these, a species of Cymatogaster of a roseate tint, with two darker spots below the soft dorsal, was first noticed in the autumn of 1879, when a single specimen was shown me by a dealer who perceived its peculiarities, but would not part with the specimen. A second example was secured for Prof. Jordan, who has since found a third; so that it is evident that at this point the species is rare.

The number of species included in the family Chiridæ, a group of fishes with the suborbital bone united to the pre-operculum, as in the Scorpænidæ and Cottidæ, from which, however, they differ considerably in appearance, is on the increase.

Several species of Chirus and its nearly allied forms, and four or five of more distantly related genera, have long been known; but we can now report three new forms: One of these belongs to Gill's genus Pleurogrammus, distinguished from Chirus by the

continuous dorsal fin and longer gill-rakers; and was described from specimens brought from Alaska by Mr. W. J. Fisher; the second is a true Chirus, not uncommon in the markets of this city, and the third is a very peculiar form, constituting a subfamily.

The species of the genus Chirus are called sea-trout by some dealers in our markets, while others confound them with the Scorpænidæ under the common name of rock-fish or rock-cod. The species found in our markets are very nearly related to each other, so much so that were it not for the unvarying pattern of the coloration, it would be hard to tell them apart. The peculiar form just mentioned does not look like a Chiroid, but closely simulates the sea-perches, such as the Jew-fish. As, however, it has the structure of the cheeks which distinguishes the Chiridæ, Prof. Jordan believes it must be placed along with them. It is certainly intermediate between the Chiridæ and the Scorpænidæ, and must be gathered into one of them. The Chiridæ, like the viviparous perch, are peculiar to the North Pacific, but the large family of the Cottidæ or Sculpins, is much more widely spread.

Three additional forms of Cottidæ have lately been described. One of these was characterized by Dr. Steindachner, in 1873, as *Artedius pugettensis*. Before his paper was received here, I had published a notice of it under the name of *Chitonotus megacephalus*. It is probable that the latter genus will stand good, as the fish certainly cannot be placed along with the previously known *Artedius notospilotus*. A second species is tolerably common in our markets, to which it is brought among the heaps of prawns and small fishes. A third occurs in the fresh-water lakes of the Island of Kodiak, Alaska, and belongs to the well-known genus Uranidea.

A fortuitously obtained trio of fishes, said to be from deep water, has enriched our coast with another family of fishes peculiar to it. Blennoid in aspect, with soft and flexible bones, a continuous dorsal without any definite spines, and a long anal, Prof. Jordan believes that its affinities are with the Trachinids. Two species are known, one of them scaleless, but with small prickles upon the fins, and prickly scutellæ along the lateral line; the other scaly, and differing considerably in other respects, so that it is not improbable that several intermediate forms will ultimately be found.

To the fishes before mentioned must be added a singular hump-backed Catostomus from the Gila, said to be tolerably abundant; an Osmerus which has hitherto escaped notice, though sufficiently common in the San Francisco market; a Lycodoid (*Leurynnis paucidens*), a Scomberoid (*Chriomitra concolor*), and a Myxine (*Bdellostoma stoutii*) from the same locality; a well characterized species of Hemitripterus from Alaska, and a Sparus from Magda-

lena bay, Lower California; all noticed by the writer; and three rays found south of San Francisco by Prof. Jordan.

The Myxine may possibly prove to be identical with one previously described from the coast of Chili (*Bdellostoma polytrema*), as it is said that the number of gill openings was not accurately counted in the Chilian type, but there is also a difference in the number of teeth. Of the three rays mentioned, one is a Dasybatis, the second is a form connecting Dasybatis with Raia, while a third is a Raia.

Altogether about forty species of marine fishes have been noted by Prof. Jordan and myself during the past eighteen months, and as the former is only at the commencement of his labors, and has only searched the coast from San Francisco southward, it is probable that he will find several more between the latter point and Puget sound.

From the immense stretch of sea coast included in Alaska, a continental line of more than twice the length of that of the Pacific coast of the United States, we may expect many additional species when the United States Fish Commission gets fairly to work upon it.

Glyptocephalus pacificus and *Glyptocephalus zachirus*.—The reason that these two species escaped description so long is probably to be found in the fact, that those brought to the market are brought from Point Reyes, about thirty miles north of San Francisco, where there was no fishery until about three years ago. Neither of these species is at any time taken in abundance, and both are absent from the market, with rare exceptions, during the winter months, so that it is probable that at that season they resort to deeper water.

Scorpis californiensis.—This species, hitherto believed to be of rare occurrence, has been ascertained by Prof. Jordan to be the most common species in the Santa Barbara channel, constituting the bulk of the catch taken for the Los Angeles market.

Torpedo californica.—This species is, I believe, rare in collections. The only example in our local museum is the small alcoholic specimen which probably formed the type of Ayres' original description. It was therefore with some interest that I observed in our market a large individual, taken in Tomales bay.

I subjoin a few dimensions:

	Feet.	Inches.
Total length	3	½
Greatest width across pectoral fins when first measured	2	
Ditto after lying spread out for about 24 hours	2	2⅛
Width across ventrals	1	1
Longitudinal diameter of eye		½
Front of disk to center of mouth when the latter is closed,		2⅜
Ditto to angle of mouth		3½
Ditto to first dorsal	1	11⅜
Ditto to second dorsal	2	3¼
Ditto to vent	1	9½
Interocular width		3

	Inches.
Distance between the spiracles	$2\frac{1}{4}$
Width across caudal fin	x$\frac{1}{2}$
Length of base of 1st dorsal	$2\frac{7}{8}$
Height of 1st dorsal	4
Length of base of 2d dorsal	$1\frac{1}{8}$
Height of 2d dorsal	2
Front of disk to eye	$2\frac{1}{3}$
Ditto to anterior edge of spiracles	4
Length of spiracular opening	1

The dealers state that this fish attains still larger dimensions.

Cephaloscyllium laticeps.—This species is one of the most singular additions to the fauna of our coast hitherto made. It was previously known only from two examples and a skull, all from New Zealand. Below Point Conception, Prof. Jordan found this curious shark, which has the power of inflating itself after the fashion of a balloon fish (Diodon tetrodon) to be the most common of its tribe, so common, indeed, that it is largely taken for the sake of the oil that can be procured from it. It attains a length of rather more than three feet, and has a very broad head, equal in width to one-fourth the total length of the fish. It does not inflate its skin, but its stomach, as was experimentally proved, and when inflated, floats away upon its back.—*W. N. Lockington.*

Case of Protective Mimicry in a Moth.—On June 6th, my son called my attention to what I without hesitation supposed to be a *Polistes fuscus* resting on the ground. Fearing to handle it, I attempted to hold it down with a stick, when on getting nearer to it I saw that it was a harmless Egerian moth, *Trochilium polistiformis.* Though a little shorter it closely resembles in size, color and peculiar markings our common Polistes wasp. The antennæ are very similar, with the brown thorax and fore-wings, and the two yellow rings on the basal half of the abdomen are also closely similar to the markings of the wasp. Now if I was deceived, why should not a bird be "taken in" and pass by the harmless moth, thinking it a well armed wasp? I regard this Spilomyia as an admirable instance of protective resemblance. A similar example I recorded several years since when I extended my net to catch what I supposed to be a white-faced wasp, and just before capturing it, found that it was a Syrphus fly (Spilomyia).—*A. S. Packard, Jr.*

Male eels in Holland.—An article on the reproductive organs of male eels and the differences between the sexes, is contributed to Zoologischer Anzeiger for June 7, by S. T. Cattie, of Arnheim, Holland. He says, "that it is not to be wondered at that male eels are so seldom found, since the young eel finds its way into deep water; there the reproductive organs rapidly develop (6–8 weeks); they then lay eggs, and the old eels, both female and male, die after reproduction. Hence the spermatozoa are wanting and in most cases even the mother-cells of the testes, so

that the study of the histological structure of the organs of Syrski can bring us somewhat nearer to the truth of the matter." He then describes the lobulated organ of Syrski, found also in American males by Packard and Kingsley. Cattie also describes what he regards as the seminal duct, previously studied histologically and so considered by Freud.[1] Its structure is like that of the immature testes of fishes. In the largest of the eel with the organs of Syrski (lappenorgan), which was 445 centimeters in length, Cattie found a tube-like cord, which extends from the base to the end of the bow-shaped indentation of the streak which extends along the testes, and which is filled with cells. This string of cells shows the most undoubted similarity to the sperm mother-cells of the testes. He observed no spermatozoa in his eels.

Cattie then quotes the sexual differences in the eel given by Jacoby.[2] These are differences in the head; which is broader in the females, than the narrower and more pointed snout of the eels with the lobulated organs of Syrski; all the females moreover have a higher, broader dorsal fin than the males, while the latter are said to be darker green, more metallic on the sides, and blacker on the back of the body; and eels with the organs of Syrski have larger eyes, though Jacoby states that large-eyed females also occur. Cattie's measurements confirm Jacoby's statement that the females have a higher dorsal fin; he thinks that the females on the whole have larger eyes, while the best external sexual difference is the smaller and more pointed, less flattened, more convex head of the males; but he found no permanent differences of coloration.

It will thus be seen that there appears to be slight external differences between the male and female eel, while the internal differences between the reproductive organs are well marked and obvious. No one in Europe has yet found spermatozoa, while in this country Packard and Kingsley in their joint paper in this journal (Vol. XIII, p. 319, 1879) claim to have seen the spermatozoa; viz.: Mr. Kingsley is confident he saw them, Dr. Packard not however being present when they were discovered and not seeing them. It is of course most desirable that others should observe these bodies before the matter can be regarded as finally settled.

NOTES ON THE WINTERING OF THE ROBIN.—I see that in the last NATURALIST, the appearance of robins at Evanston, Ill., is made the text for a theory of bird migrations. In Western Iowa, at about the same latitude, robins remain in wooded valleys throughout the winter. Last December I observed them in flocks in the underbrush along the Missouri river, opposite Plattsmouth, Neb. On the uplands, which are about three hundred feet higher and

[1] Litzungsberichte der Kais. Akad. der Wissenschaften. Wien, 1877, Märzheft.

[2] Dr. L. Jacoby, Der Fischfang in der Lagune von Commachio.

more open, they are not frequently observed during the winter months.

C. J. Maynard records the robin as a resident of Eastern Massachusetts, although they sometimes do not remain all winter. *Chrysomitris tristis* is also found here abundantly during the winter. *Lophophanes bicolor*, *Sitta carolinensis* and *Centurus carolinus* have been noticed more rarely.

May it not be that a few warm days in spring call out the earlier birds from neighboring wooded valleys rather than from the south? Yet I see no serious objection to the idea that the migration of birds is largely due to the prevailing winds.—*J. E. Todd, Tabor, Iowa.*

THE EYES AND BRAIN OF CERMATIA FORCEPS.—Mr. Norman N. Mason has made preparations of the eyes of this myriopod, which, contrary to the statement in this journal last year, is not uncommon in Providence, R. I., in dark places, and which is useful as a spider-destroyer. The eye of this myriopod appears to be constructed on the same plan as that of other species of the subclass, but differing in important respects. Though Cermatia is said to have compound eyes in contradistinction from the so-called "ocelli" of other myriopods, the latter are likewise truly aggregated or compound, the "ocelli" being composed of contiguous facets, the nerve-fibres supplying them arising in the same general manner from the optic nerve as in Cermatia, where the facets are much more numerous. The eye of the Cermatia is composed of a hemispherical, many-facetted cornea, the lenses of which are shallow, doubly convex, being quite regularly lenticular, the chitinous substance being laminated as usual. Each corneal lens is underlaid by a retina about as thick as the cornea, the inner surface of each retinal mass being convex. Corresponding to each lens is a separate mass of connective tissue which increases in thickness from the end of the optic nerve outward towards the cornea; though the entire retina of the eye extends back to the *ganglion opticum.* Within the broad stratum of connective tissue, forming the entire retina of the eye, lies next to the corneal lens a layer of "vitreous cells" or "lens-epithelium" of Graber. This layer is succeeded by the series of rather large visual rods, one in each mass corresponding to each corneal lens; these rods are long and sharp, conical at the end, which extends nearly to the inner edge of the retinal mass; they each possess a nucleus, and the connective tissue enveloping the rods is nucleated, while there is an irregular layer of nucleated cells near or around the ends of the rods. There are no cones; these not being yet detected in the eye of myriopods.

This layer of cells is succeeded by a thin, slightly curvilinear, transverse strip of connective tissue passing through the entire eye, and behind it are the loose, nucleated spherical cells forming the *ganglion opticum.*

The brain of *Cermatia forceps*, as shown by several sections, is

developed on the same plan as in Bothropolys, and so far as we see, the myriopodan brain corresponds more closely in its general form and histology with that of the insects than the Crustacea. The large, thick optic nerve arises from the upper side of each hemisphere. The median furrow above is deep, and on each side is a mass of small ganglion cells; also a mass in the deep fissure below the origin of the optic nerve, and another mass on the inferior lobe extending down each side of the œsophagus, probably near or at the origin of the posterior commissure. These masses, *i.e.*, those on the upper and under side of the brain, connect on each side of the median line, and in this respect the brain is as in Bothropolys. There are no large ganglion cells as in Crustacea, including Limulus.

There is then, no very close resemblance in form or histology, between the eye and brain of Limulus and the myriopods, the two types of eye being essentially different.—*A. S. Packard, Jr.*

ZOOLOGICAL NOTES.—A communication by Dr. W. J. Hoffman, on a supposed hybrid between the lynx and domestic cat, was lately read before the Zoölogical Society of London.——The second example of Archæopteryx, with the head, is now on deposit in the Geological Museum of Berlin. It was bought, according to *Nature*, for about $5000, by Herr Siemens, of Berlin, in order to save it from importation to the United States.——M. Viallanes finds that the heart of insects is at first a simple tube open only at its two ends. So long as it has no lateral orifice it is completely arterial.——Undoubted alligators have been discovered in the Yang-tse-Kiang, the first of this genus to occur in the Old World. In the same river occurs the Polyodon, the only other existing species of this ganoid living in the Mississippi.——Prof. E. Van Beneden has discovered the existence of a double circulatory apparatus and two kinds of blood in parasitic Copepoda (Clavella, Congricola and Lernanthropus). The leaf-like lamellæ growing from the end of the body of Lernanthropus are true gills, like those of Annelids. There is no true heart; the circulation of the two fluids being caused by the contraction of the body. In certain worms, the closed vessels contain a red blood without corpuscles, while the connected lacunæ of the body (not true vessels) contain colorless blood with white corpuscles.——The use of the swimming bladder of fishes is to regulate the migration of fishes, according to M. Marangoni. They have to counteract its action by their fins. It produces a double instability, one of level, the other of position.

ANTHROPOLOGY.[1]

PUEBLO INDIANS.—The Pueblos of New Mexico and Arizona are towns or villages inhabited by Indians of various races and speaking different languages. When we omit the Indians inhab-

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

iting the Middle Gila river, who are also sometimes spoken of as Pueblo Indians, the languages of the others are divisible into four families.

Shinumo.—The *Shinumo* (sometimes called *Móki)* speak a language of the Sho-sho-ni-an, considerably differing, however, from the neighboring Pai-Ute, Uta and Californian dialects of this family. They occupy six of a group of seven Pueblos—the seventh speaking a language of the Téwan—each under its own chief. These are the only Pueblos in Arizona, the remainder being within the limits of New Mexico.

The following authors are known to have written or left manuscripts on this language:

PALMER, DR. EDWARD.—Vocabulary of about 200 words (MSS.).

PALMER, CAPT. A. D.—Vocabulary of about 200 words (MSS.).

SIMPSON, J. H.—Vocabulary of the Moqui, 38 words. (In Journal of a Military Reconnaissance &c., Wash., 1850, 8vo.)

BUSCHMANN, J. C. E.—"Völker und Sprachen Neu-Mexicos." Akad. der Wissenschaften. Berlin, 1856, 4to.

LOEW, OSCAR—Vocabulary of about 200 words and some elements of grammar. In A. S. Gatschet "Zwölf Sprachen," Weimar, 1876, 8vo.

POWELL, MAJ. J. W.—Vocabulary of the Shinumo, taken at Oraibi, one of the Pueblos (MSS.).

Zunian.—Zuñi (pron. Súnyi), a comprehensive name given to three inhabited and as many ruined Pueblos in Northwestern New Mexico, south of the Navajo Reservation: Zuñi, Old Zuñi or Cibola (ruined).

The linguistic literature is as follows:

SIMPSON, J. H.—Vocabulary of Zuñi, about 40 words in Journal of Military Reconnaissance, &c., pp. 14c–144, Wash., 1850, 8vo.

EATON, CAPT. J. H.—Vocabulary including numerals. (In Schoolcraft, Vol. III, pp. 416–432.)

WHIPPLE, LIEUT. A. W.—Vocabulary in Pacific R. R. Rep., III, 2, pp. 91–93.

BUSCHMANN, J. C. E.—"Völker und Sprachen Neu-Mexicos." Akad. der Wissenschaften, Berlin, 1856, 4to.

PALMER, DR. E.—Vocabulary of about 60 words (MSS.).

KLETT, FRANCIS—The Zuñi Indians of New Mexico. In Popular Science Monthly, N.Y., 1874, pp. 58c–591 (illus., Ethnological).

STEVENSON, J. S.—List of names given to Zuñi pottery, 1879 (MSS.).

Kéran.—*Kéra*, Span. Quera, plur. Queres, an ancient name of unknown signification given to Pueblo Indians west of the Rio Grande. Locally they are divided into two branches: 1. A northeastern branch on the Rio Grande, embracing San Felipe, Santo Domingo, Cótchiti, Santa Aña and Cia (Silla, Tse-a); 2. A western branch on the Rio San Juan, embracing Kawaikome, Laguna, Povate, Hasatch and Mogino.

The linguistic literature is as follows:

SIMPSON J. H.—Vocabulary of Kéra, about 30 words. (In Journal of Military Reconnaissance, &c., Wash., 1850, pp. 14c–143, 8vo.)

DAVIS, W. H. H.—'El Gringo, or New Mexico and her people," N. Y., 1857, pp. 157–159, 8vo.

WHIPPLE, LIEUT. A. W.—Vocabulary of Kiwomi, about 200 words, and of Cochitemí, about 60 words. (In Pacific R. R. Report, III, 2, pp. 86–89.)

BUSCHMANN, J. C. E.—"Völker und Sprachen, Neu-Mexicos." Akad. der Wissenschaften, Berlin, 1856, 4to.

LOEW, OSCAR.—Vocabulary of Santa Aña, about 200 words and a few sentences. (In A. S. Gatschet "Zwölf Sprachen," Weimar, 1870, 8vo.

LOEW, OSCAR.—Vocabulary of Laguna. (*Ibid.*)

KLETT, FRANCIS—Vocabulary of Acoma, about 60 words, 1873 (MSS).

MENAUL, JOHN—Te. cher in Laguna. Specimens of Laguna primer and catechism, with interlinear English translation (MSS.).

Téwan.—The largest number of Indian towns in New Mexico, along the Rio Grande, speak dialects of the Téwan. It seems that in former times these dialects extended far into Texas and Chihuahua, along the same river, though only a few scattered remnants of them are now remaining there.

Of this family five main divisions may be made, these being mutually unintelligible:

1. Taño: Isleta; another Isleta near El Paso; Sandía.
2. Taos: Taos (Indian, Taxé); Picuni.
3. Jemes: Jemes (old Pecos is consolidated with it).
4. Tewa or Tehua ("house, houses"): San Ildefonso, San Juan, Pojoaque, Nambe, Tesuque, Santa Clara and one of the Moki Pueblos. Of these Pueblos, Santa Clara is the only one located on the western bank of the Rio Grande.
5. Piro in Sinecú, south of El Paso.

Linguistic literature:

SIMPSON, J. H.—Vocabulary of Jemes, etc., 30 words, pp. 140–143, reprinted in Davis, "El Gringo."

WHITING, DAVID V.—Vocabulary of Tesuque, about 400 words. (In Schoolcraft, III, pp. 446–450.

BUSCHMANN, J. C. E.—"Völker und Sprachen," Berlin, 1856, 4to.

LOEW, OSCAR—Isleta, Jemes, San Ildefonso, San Juan, vocabulary of about 230 words each, and sentences from Tesuque (about fifty). (In A. S. Gatschet, "Zwölf Sprachen," Weimar, 1876, 8vo.)

PALMER, DR. E.—Vocabulary of Taowa (MSS.).

BARTLETT. J. R.—Vocabularies of Piro, of Sinecú, of Tigua (viz: Téhua, Tewa) (MSS).

YARROW, DR. H. C.—Vocabulary of Los Luceros (MSS.).
Vocabulary of Los Taos. In A. S. Gatschet's "Zwölf Sprachen," Weimar, 1876, 8vo.

KANTZ, AUG. V.—Vocabulary of Isleta, 1869 (MSS.).

GIBBS GEORGE—Vocabulary of Isleta, 1868 (MSS.).

—*J. W. Powell.*

PRE-ADAMITES.—This designation is the external title of a volume just issued in Chicago, by S. C. Griggs & Co., of which the full title is as follows: "Pre-adamites; or a demonstration of the existence of men before Adam; together with a study of their condition, antiquity, racial affinities and progressive dispersion over the earth, with charts and other illustrations, by Alexander Winchell, LL.D." The paper, press work and illustrations are

excellent, and reflect great credit on the publishers. The work consists of 478 pages, and may be considered under three very different aspects, the biblical or exegetical, the ethnographical or descriptive and the ethnological or deductive.

From an exegetical point of view, the author states that the account of Creation in Genesis has long been interpreted to mean, 1. That the world, with all it contains, was created by God; 2. That this occurred 4000 years B. C.; 3. That it was accomplished in six days; 4. That Adam was created on the sixth day: 5. That Eve was formed from a rib of Adam; 6. That Adam and others lived over 900 years; 7. That the creation of man occurred in Western Asia; 8. That about 1656 A. M. a deluge destroyed the whole race save Noah and his family; 9. That all existing races came from Noah; 10. That the black races descended from Ham.

On the contrary, Prof. Winchell holds, and defends with a great deal of learning, that the three dispersions of the posterity of Noah refer to the white race alone, embracing the blonde family (Japhetites or Aryans), the brunette family (Semites) and the sun burnt family (Hamites). The brown races, both Mongoloid (Tartar, Turanian) and Dravidian, and the black races, including Negro, Hottentot, Papuan and Australian are extra-Noachic and extra-Adamic.

All the legitimate and logical results from such a position are fully and freely admitted by the author; such as the rejection of the old chronology, non-inspiration of the narrative portion of the Old Testament, the application of apparent names of individuals to tribes or nations.

In the ethnographic portion of the volume, the author has done his best work. It is not too much to say that there is no single work in our language which brings together so much of the latest investigations concerning the tribes of men inhabiting our planet, and their distribution over the continents. Much of this is provisional. If the work of Mr. Keane, lately mentioned in these notes, demonstrating a large infusion of Aryan blood and language throughout the Polynesian group, should hold good, Prof. Winchell would have to review his Adamic, or rather his Noachic, studies to find the limit of mixture between the Adamite and the Pre-adamite.

The discussions of ethnological problems show that the author is cognizant of the latest phases of the subject. The one to which he devotes the most space and in which he gives loose reins to his glowing style, is the question of racial distinctions and the possibility of degeneracy. Some of his reflections upon Negro inferiority in answer to Drs. Strong, Whelan and others, will, doubtless, bring down upon him no little castigation. Apropos of degeneracy, Prof. Winchell makes a very neat distinction between *structural* and *cultural* degradation, pp. 274–282, main-

taining that the former rarely or never occurs, and that the oft-mentioned instances of race degeneracy is cultural or circumstantial.

In the later chapters of the work the genealogy of the three groups of races, the cradle of humanity, the antiquity of man and his priscan condition are ably and exhaustingly discussed.

In conclusion, there is no doubt that whether the author desires it or not, this volume will excite more good, faithful study, and more ill-tempered writing on the subject of anthropology than any other work that has appeared in our country during the last decade.

MATERIAUX POUR L'HISTOIRE DE L'HOMME. — This old and established journal plods along, and although mainly devoted to local matters, contains, occasionally, papers of general interest. Nos. 7–12, 1879, are before us with the following budget: In No. 7 MM. Cazalis de Fondouce and Helbig treat of the archæology and early history of Italy, with bibliographical references. Dr. Noulet reviews M. Mourai's work on the age of polished stone and of bronze in Cambodia. At the close of the number will be found a review of the labors of the Swedish Anthropological Society. No. 8 is taken up with brief reports on the anthropology of the French Association of 1879, and also of the German Congress of Anthropologists. Nos. 9 and 10 give us valuable summaries upon the labors of Abbé Bourgeois and of the Anthropological Society of Berlin, and a programme of the forthcoming Congress of Archæologists at Lisbon, and of the Congress of Americanists. The last number of the year is the most attractive, being nearly taken up with a paper upon the tumuli of Avezac (Hautes-Pyréneés), illustrated by five beautifully executed lithographic plates.

With Nos. 1 and 2 of 1880, this standard journal enters upon its eleventh year. No. 1 opens with a paper, by Dr. Gross, upon the latest discoveries in the lacustrian habitations of Lake Bienne, a small expanse of the river Aar, north of Lake Neufchatel. The interest in the investigations is heightened by the fact that the draining of the marshes has rendered the old sites amenable to cultivation, and the farmers have not been slow in taking up these rich bottom lands. Some old lacustrine stations have already disappeared entirely, and others are fast giving place to the ploughed field. This fact makes the labors of Dr. Gross and his co-laborers of the utmost importance. The remainder of this and the following number is taken up with reviews, a large portion being devoted to Prof. Whitney's Calaveras cranium and the Peabody Museum of Cambridge.

The ninth session of the International Congress of Anthropology and Prehistoric Archæology will be held in Lisbon, Sept. 20–29. President, J. de Andrade Corvo.

ARCHÆOLOGICAL HINTS.—Mr. Josiah Morrow, in a letter to the Smithsonian Institution, describes a work in Warren county, Ohio, in which the earth of the banks is very much altered by fire. Is there any evidence in this of Mr. Morgan's theory that many of our earthworks were sites of communal dwellings? The earth may have been baked by the lodge fires.

In a conversation with Mr. Stevenson about the process of pottery manufacture among the Pueblo Indians, I found that the women, in making those symmetrical, round-bottomed jars, use as a support a box of fine dry sand. They turn the mass around in the sand while they are working it up into shape. After finishing the jar, they wash off the sand and cover the surface with a thin paste of prepared clay and water. In this rude support, so secure and yet so yielding, I could but see the predecessor of the potter's wheel. Since writing the foregoing, I have seen Mr. Schumacher's account of pottery making in California, which confirms my view.

The same Indians in making their wares, owing to the scarcity of fresh water, use the brackish waters of the saline pools. The clay itself is also impregnated with salt. It may be that this necessity, so frequently the "mother of invention," is the true secret of the quasi glazing found upon much of the Pueblo pottery, especially the oldest.—*O. T. M.*

PROF. FLOWER'S LECTURES.—During the past season Prof. J. W. Flower delivered a course of lectures before the Royal College of Surgeons in England. We have earnestly desired to see a full report of them, but as yet the best account is a series of short reviews in the *British Medical Journal* for April and May of this current year.

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COCKBURN, J.—Stone implements from the Khasi hills. *J. Roy. As. Soc. of Bengal*, XLVIII.

Chippers of Flint. (*Cornhill Mag.*) *Eclectic Mag.*, May.

Crania of Murderers. *St. Louis Courier of Med.*, April.

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Kirghiz Proverbs. *Academy*, March 27.

Memory, Indian powers of. (*Athenæum*) *Living Age*, April 17.

RAWLINSON, H. C.—Notes on a newly-discovered clay cylinder of Cyrus the Great. *J. Roy. As. Soc. of Gr. Britain*, Jan.

RECLUS, E.—Studies of primitive peoples. *Internat. Rev.*, May.

ROBERTSON, R. S.—The Mound-builders of America. *Mag. of Am. History*, March.

ROYLE, J. R.—Indian metal work. *Magazine of Art*, April.

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STOUT, REV. H.—Inscriptions in Shimabara and Amakusa. *Tr. of As. Soc. of Japan*. VII, iii.
TAYLOR, E. C.—Musical instruments of all ages. *Nat. Repository*, April.

GEOLOGY AND PALÆONTOLOGY.

EXTINCT BATRACHIA.—The recent discoveries of Dr. Anton Fritsch in the Permian "gaskohle" of Bohemia,[1] have added greatly to the interest of this subject. This gentleman has discovered many specimens in an excellent state of preservation. This enables him to give details of the osteology of several types, which has been hitherto a desideratum. He refers all the *Batrachia* to the *Stegocephali*, and has, up to this time, given an account of the species of three families, for which he uses the names *Branchiosauridæ*, *Apateontidæ* and *Æstopoda*. He gives thorough accounts of the structure of a leading genus in each, of *Branchiosaurus*, *Melanerpeton* and *Dolichosoma* respectively. The specimens are so well preserved that his descriptions and figures are very instructive. He shows that *Branchiosaurus* possessed branchiæ apparently internal, and of a totally different type from those of existing gilled *Batrachia* or their extinct representative, *Cocytinus*, from the coal measures of Linton, Ohio. *Dolichosoma* was, like our *Phlegethontia*, a snake-like form, with ribs and without extremities, and with external gills. The presence of ribs distinguishes it from our *Phlegethontia*, although Dr. Fritsch thinks the present writer in error in denying them to the latter genus. He thinks he sees them in the figure of *P. serpens* in Vol. II of the Palæontology of Ohio. The marks in the position of ribs on the block there figured, were stated to represent, in all probability, traces of the longitudinal tendons so well developed in *Amphiuma*, and they furnish no ground for a belief in the presence of ribs. Dr. Fritsch describes some curious pectinate bones which he supposes to belong to the external generative organs of *Ophiderpeton*.

Dr. Wiedersheim gives[2] a very full account of the osteology of an only moderately preserved specimen of a batrachian from the Bunter sandstone (Lower Trias) of Switzerland. The structure of the pelvic and scapular arches, and of the limbs, are best given, and a cast of the cranial cavity is described. He reviews the systematic work previously done, intercalating his own results. We remark here that in one instance he takes an analytical key of genera given by Cope for a systematic classification, and very naturally criticises it adversely.

[1] Fauna der Gaskohle und der Kalksteine der Permformation Boehmens. Prag 1878–1880.

[2] *Labyrinthodon rütimeyeri* Abh. d. Schweiz. Palæont. Gesselsch. Von. R. Wiedersheim. Zürich, 1878.

ARCHÆOLOGICAL HINTS.—Mr. Josiah Morrow, in a letter to the Smithsonian Institution, describes a work in Warren county, Ohio, in which the earth of the banks is very much altered by fire. Is there any evidence in this of Mr. Morgan's theory that many of our earthworks were sites of communal dwellings? The earth may have been baked by the lodge fires.

In a conversation with Mr. Stevenson about the process of pottery manufacture among the Pueblo Indians, I found that the women, in making those symmetrical, round-bottomed jars, use as a support a box of fine dry sand. They turn the mass around in the sand while they are working it up into shape. After finishing the jar, they wash off the sand and cover the surface with a thin paste of prepared clay and water. In this rude support, so secure and yet so yielding, I could but see the predecessor of the potter's wheel. Since writing the foregoing, I have seen Mr. Schumacher's account of pottery making in California, which confirms my view.

The same Indians in making their wares, owing to the scarcity of fresh water, use the brackish waters of the saline pools. The clay itself is also impregnated with salt. It may be that this necessity, so frequently the "mother of invention," is the true secret of the quasi glazing found upon much of the Pueblo pottery, especially the oldest.—*O. T. M.*

PROF. FLOWER'S LECTURES.—During the past season Prof. J. W. Flower delivered a course of lectures before the Royal College of Surgeons in England. We have earnestly desired to see a full report of them, but as yet the best account is a series of short reviews in the *British Medical Journal* for April and May of this current year.

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GEOLOGY AND PALÆONTOLOGY.

EXTINCT BATRACHIA.—The recent discoveries of Dr. Anton Fritsch in the Permian "gaskohle" of Bohemia,[1] have added greatly to the interest of this subject. This gentleman has discovered many specimens in an excellent state of preservation [illegible] enables him to give details of the osteology of several types [illegible] has been hitherto a desideratum. He refers all the [illegible] the *Stegocephali*, and has, up to this time, given an account [illegible] species of three families, for which he uses the names [illegible] *sauridæ*, *Apateontidæ* and *Æstopoda*. He gives [illegible] accounts of the structure of a leading genus in each [illegible] *saurus*, *Melanerpeton* and *Dolichosoma* respectively [illegible] mens are so well preserved that his descriptions [illegible] very instructive. He shows that *Bran*[illegible] branchiæ apparently internal, and of a [illegible] those of existing gilled *Batrachia* or their [illegible] *Cocytinus*, from the coal measures of [illegible] was, like our *Phlegethontia*, a snake-like [illegible] out extremities, and with external [illegible] distinguishes it from our *Phlegethontia* [illegible] thinks the present writer in error [illegible] genus. He thinks he sees [illegible] Vol. II of the Palæontology of [illegible] of ribs on the block there figured [illegible] probability, traces of the [illegible] in *Amphiuma*, and they [illegible] presence of ribs. Dr. [illegible] bones which he [illegible] organs of *Melanerpeton*

Dr. W[illegible] an only [illegible] Bunter sandstone [illegible] of the [illegible] and a cast of the [illegible] systematic [illegible] We remark [illegible] of genera [illegible] naturally [illegible]

[1] Fauna der Gaskohle [illegible] 1878–1880.

[2] *Labyrinthodon* [illegible] dersheim. [illegible]

Prof. Cope, in the Proceedings of the American Philosophical Society for May, 1880 (Palæontological Bulletin, No. 32), enters into the structure of the genera *Eryops* and *Trimerorhachis*, and re-defines the sub-order *Ganocephala*, showing that it differs materially from other *Stegocephali* in the structure of the vertebral column.

The present occasion is a convenient one for a further addition to the subject, which chiefly concerns the genus *Cricotus*.[1] This remarkable form has been characterized in this journal[2] and elsewhere[3] by the complete development of its centra and intercentra, both of which form entire vertebral bodies and in pairs support single neural arches. No such character has been detected in the known divisions of the *Stegocephali*, but before establishing a new one for it, I have waited further information. Additional knowledge of its structure shows that it is the type of a distintinct division of the *Stegocephali*, which may be defined as follows:

Centra and intercentra subequally developed as vertebral bodies, a single neural arch supported by one of each, forming a double body. Chevron bones supported only by intercentra. Basioccipital vertebral articulation cup-like, connected with the first vertebra by an undivided discoid intercentrum.

Thus the peculiarity of the vertebral column in general is carried into the cephalic articulation, and we have, instead of the complex atlas of the *Ganocephala*, a single body connecting occipital condyle and first vertebra. This body represents, in all probability, the *single occipital condyle of the Reptilian skull.* This part, as is well known, remains cartilaginous in the lizard[4] long after the basioccipital is ossified, and is a distinct element. The structure of *Cricotus* shows that it is a connate intercentrum. We have now removed the last difficulty in the way of the proposition that the *Reptilia* are derivatives of the *Batrachia*, viz: the difference in the cranio-vertebral articulation. But the former have not been derived from the *Labyrinthodontia* as has been suggested, nor from the *Ganocephala*, but from the *Embolomera*, as I call the new order, or sub-order. The order of *Reptilia* which stands next to it is, of course, the *Theromorpha*, which presents so many Batrachian characters, including intercentra, as I have for the first time pointed out in the paper above quoted. Besides *Cricotus*, Fritsch describes a genus from Bohemia under the name *Diplovertebron*, which I suspect to belong to the *Embolomera*.—*E. D. Cope.*

THE GENEALOGY OF THE AMERICAN RHINOCEROSES.—The genus *Aceratherium* has been supposed to be represented in North

[1] Cope, Proceedings Academy, Phila., 1875, p. 403.
[2] 1778, p. 319, May 22,
[3] Proceed. Amer. Philos. Soc., 1878, p. 522.
[4] See Parker on the development of the skull of the Lizard, Philos. Trans., London, 1879.

America on account of the agreement of the species of the White River beds in dentition and absence of horn, with the *A. incisivum* of Europe. It seems now that none of the American species have the four digits in the manus, which is characteristic of *Aceratherium*, but that that member is three-toed, as in *Aphelops*. Even in the Eocene period, the most rhinoceros-like genus, *Triplopus* (Cope, this Journal, 1880, p. 383), was already three-toed. The lower Miocene species show in their superior incisor teeth that their position is between the two genera named. *Triplopus* probably has, like *Hyrachyus*, incisors $\frac{3}{3}$; the *Rhinocerus occidentalis* of Leidy, $\frac{2}{1}$, while in *Aphelops* Cope, they are $\frac{1}{1}$. In *Peraceras* Cope (this Journal, 1880, p. 540) superior incisors are wanting,

The series of genera will then be as follows. The table only differs from the one already given in the NATURALIST (1879, p. 771*e*), by the interjection of the two new genera named. The collateral genera are omitted.

Cœlodonta
/
Rhinocerus. *Atelodus.*
\ /
Ceratorhinus. *Peraceras.*
\ /
Aphelops.
|
Cænopus.
*
Triplopus.

The characters of *Cænopus* are as follows. Dentition; I. $\frac{2}{1}$; c. $\frac{0}{1}$; M. $\frac{4}{4}$; M $\frac{3}{3}$. Digits 3—3. The typical species is *C. mitis* (*Aceratherium* Cope).—*E. D. Cope.*

HALITHERIUM CAPGRANDI. — M. Delfortrie, of Bordeaux, has been so fortunate as to obtain a nearly entire cranium of this sirenian, which was described by M. Lartet, in 1866, under the name of *Rhytiodus capgrandi.* A nearly entire skeleton was found in the Canton Labrède, dept. of Gironde, but was broken and scattered by the workmen. M. Delfortrie, after much labor, succeeded in obtaining the fragments of the skull. This valuable relic shows that the species was of considerable size, the skeleton is said to have been five meters in length. The skull is more elongate and narrowed forwards than in the other species of *Halitherium.*

A GENUS IN ANTICIPATION.—In a late number of the *Revue Scientifique*, M. Mortillet discusses the probable maker of the flints found in the Miocene deposits of Thenay, Cantal, and of a locality in Portugal. He rejects the proposition of Gaudry that

the artificer was the *Dryopithecus*, because the horizon of the flints is not exactly that in which the remains of that large ape occur. He proposes the hypothesis that the problematical being was the form which has intervened between the higher apes and man. Thus far M. Mortillet's positions appear to be reasonable, provided that his flints are artificial.

M. Mortillet goes further. He names the genus to which this being is to be referred, and calls it *Anthropopithecus*. As he has not the shadow of a definition for the genus, its proposition is in violation of all rules. Had he assumed the risk of furnishing it with characters, its adoption would have been a matter of time and discovery. Moreover, the name he uses is preoccupied. He then proceeds to name the species, of which he enumerates three. His method of distinguishing these is not zoölogical; they are proposed on inference as to their differential characters, which extends to size only. The dimensions are estimated by those of the flints, one species having manufactured large implements, and another small ones. It is therefore supposed that one of the species was of large size, and another one small.

We think on such a basis, we could infer several species of *Homo* on the North American continent, and as zoölogists and palæontologists, we must decline to admit such unsubstantial visions within the Walhalla of species and genera.

IGUANODONS.—Miss Agnes Crane, in a recent letter, states that the remains of the Iguanodons recently discovered in the Wealden formation at Bernissart, near Mons, on the Belgian frontier are now in process of articulation in the workshops of the Royal Museum at Brussels. M. Dupont is engaged in preparing a second and enlarged edition of his account of their discovery. Several perfect animals of various sizes were found associated with the "remains," of crocodiles, gigantic tortoises (rivaling Miocene forms), fishes and plants. The structure of the fore and hind limbs, the skull and the tail is now well known, and proves the animal to have been very different to all previous restorations. Prof. Owen is right as regards proportions of the fore limbs and the analogies he drew from them. Prof. Cope's views in relation to the posterior extremities will receive strong confirmation, while as to the "structures known respectively as the 'horn' and the 'spur,' every one was, on the other hand, far from imagining the truth."

THE GEOLOGY AND TOPOGRAPHY OF THE CATSKILL MOUNTAINS.—Prof. Hall long since showed that the mass of the *Catskill* mountains (N. Y.) consists of nearly horizontal beds of Devonian rocks of the Chemung and Catskill epochs, which rest unconformably on the Silurians. Prof. Guyot has recently published some interesting results of his observations on the region. He has, for the first time, determined the topography of the Southern

Catskills, or Shendaken mountains. He finds that they include the highest points, the Slide mountain reaching 4205 feet above tide water, and the Panther 3828. The region is an almost unbroken forest in spite of its proximity to the great centers of population. As to structure, the beds show weak plications whose axes are parallel with those of the Allegheny system, but the mountain ranges were at right angles to the system, or from north-west to south-east. This anomaly is explained by the fact that they are results of erosion. The general level descends westwards.

MICROSCOPY.[1]

MICROSCOPY AT THE AMERICAN ASSOCIATION.—There is reason to believe that the meeting of the American Association for the Advancement of Science, which is to convene at Boston, on the 25th of August, will be a memorable gathering, as well for its scientific and social character as for the numbers in attendance at its sessions. It is expected that the old sub-sections will be maintained, and new ones organized. The large number of distinguished scholars, at Boston and vicinity, can hardly fail to give to the sub-section of microscopy a special prominence and importance this year. Ample arrangements have been made for the convenience of this department. The Physical and Biological Laboratories of the Institute of Technology have been secured for its use; also rooms for the safe keeping of instruments, and for the giving of lectures, screen projections, &c. Communications in regard to membership, or the scientific work of the meeting, should be addressed to the present chairman of the sub section, Prof. S. A. Lattimore, Rochester, N. Y.

AMERICAN SOCIETY OF MICROSCOPISTS.—This Society will meet at Detroit, August 19, according to plans previously announced. A large meeting is expected. The proceedings of last year's meeting have been issued and distributed. A supply of extra copies were published, which can be obtained at a reasonable price, by addressing the Secretary, Dr. Henry Jameson, Indianapolis, Indiana. Instead of the medal offered last year for the best specimens illustrating some common adulteration, the donor will substitute, with consent of the winner, the superb half inch objective now made by the Bausch and Lomb Optical Co., having nearly 100 degrees aperture and capable of resolving *P. angulata*. This is a great improvement on the original offer.

"SCIENCE"—A new weekly scientific journal is announced under this title. It is designed to have somewhat the character of the English "*Nature*." Astronomy will be the most prominent feature, but it is proposed to give adequate room to microscopical news. The editor's address is P. O. Box 3838, New York.

[1] This depa tment is edited by Dr. R. H. WARD, Troy, N. Y.

MICROSCOPISTS' ANNUAL.—The first number (for 1879) of this little manual, has just been issued by the publishers of the American Journal of Microscopy. In addition to lists of Microscopical Societies, manufacturers, dealers, &c., it contains much miscellaneous information of interest to microscopists, in regard to weights, measures, postal regulations, magnifying powers, etc. Being unable to obtain recent information in all cases, the lists are partly based upon old data with the hope of correcting them in subsequent editions.

SCIENTIFIC NEWS.

— Caleb Cooke died in Salem, Mass., June 5, 1880, aged 42 years and 4 months, of typhoid malarial, the result of disease contracted at Zanzibar. Mr. Cooke was for some time a pupil of Agassiz. In 1859 he went to Para, South America, and afterwards to Zanzibar and Madagascar, remaining for about two years on the eastern coast of Africa, sending important collections to Agassiz's museum. The insects collected by him in Zanzibar, largely formed the materials for Gerstaecker's volume on the insects of Zanzibar. He was one of the curators of the Essex Institute, and at the time of his death the curator of Mollusca in the Peabody Academy, and was one of the most zealous of its officers from the date of its foundation. Mr. Cooke was an excellent and indefatigable collector and rendered most valuable assistance to investigations. He did much in local zoölogy. Though he was not a productive student of nature, he was, however, one of those useful, unselfish naturalists, with an ardent love of nature, who are careless of their own reputation, and aid in building up the fame of others. Mr. Cooke rendered important services to the U. S. Fish Commission for several seasons, when dredging in deep water was carried on in the Gulf of Maine, aboard the U. S. Coast Survey Steamer *Bache;* he explored Mammoth cave, and one of the most interesting of the insects inhabiting that grotto was dedicated to him, as were other insects discovered elsewhere by him. He also, in 1875, was an assistant of the Geological Survey of Indiana.

Mr. Cooke wrote but little; he contributed several notes to the NATURALIST, and in the early years of its history was a most enthusiastic and laborious assistant in the office work of this magazine. The writer of this notice mourns his loss, as the faithful friend of many years, who was unwearied in well doing, amiable, if sometimes with a grain of eccentricity, philanthropical, and unfailing in all the minor courtesies and kindnesses that render one's everyday life worth living.

— The School Board of Newton, Mass., have engaged Mr. J. Walter Fewkes to deliver a course of lectures on natural history to the public schools. So far as we are aware this is the first course of lectures on zoölogy to teachers, as well as students,

paid for by any city out of the appropriation for the schools, and wholly directed by the school committee. This is a movement which we feel sure will eventually be adopted in other towns and cities. We have long advocated the plan of having in each town or city a skilled teacher of natural history, who should give the instruction in elementary botany, zoölogy and geology in the schools of different grades. There is, in most towns, a person with a decided taste for these studies, who, with comparatively little expense, could give at least weekly object lessons in the different schools and to different classes in the same schools. Bringing zeal and practical knowledge at first hand to his work, such a teacher would do vastly more to interest scholars than the present method of requiring each school to supply its own teacher, who has to impart knowledge in numerous dissociated studies.

— Prof. Wm. Boyd Dawkins, of Owen's College, Manchester, England, has been invited to deliver a course of twelve lectures on "Prehistoric Man," before the Lowell Institute, Boston, Mass., the coming autumn. Prof. Dawkins is one of the most eminent of the younger scientific men of Great Britain, and has already become a standard authority in comparative anatomy and prehistoric archæology. He is a graduate of the University of Oxford, was principal geologist in H. M. Geological Survey in 1867, professor of geology in Owen's College, 1874, president of the Manchester Geological Society; and is the author of many essays and memoirs in the Royal Geological and Anthropological Societies. He published, in 1874, a popular volume showing great research, on "Cave Hunting, or Researches on the evidences of caves respecting the early inhabitants of Europe," and the present year a second volume has appeared on "Early Man in Britain and his place in the Tertiary period," which is exciting much attention. He is forty-two years of age.

— A despatch from Paris announces the death of Dr. Paul Broca, the eminent surgeon and anthropologist. He was born at Sainte-Foy-la-Grand (Gironde), in 1824. He became professor of surgical pathology in the Faculty of Medicine in Paris, and surgeon of the hospitals of Saint Antoine and La Pitie. In 1866 he was elected a member of the Imperial Academy of Medicine. Subsequently he was nominated a Chevalier of the Legion of Honor. He was a leader among modern anthropologists, and in 1878 presided over an International Congress of the followers of that branch of scientific inquiry. He was a senator of the Republic, and belonged to the Left or Radical party.

— The annual meeting of the Entomological Club of the American Association for the Advancement of Science will be held at the Museum of the Boston Society of Natural History, corner of Berkeley and Boylston streets, Boston, commencing at 2 P.M., Tuesday, 24 August, 1880. There will be an informal social gathering of entomologists at the rooms of the Boston So-

ciety of Natural History, 24 Aug., 1880, from 10 A. M. to 1 P. M. During the meeting of the American Association a room will be constantly open for the exclusive use of the entomologists.

— The appropriations by Congress at the last session was $150,000 for the U. S. Geological Survey (it asked $390,000); $25,000 for the U. S. Entomological Commission; $20,000 for the Bureau of Ethnology under the control of the Smithsonian Institution; $8000 was also appropriated for the publication of Dr. Emil Bessel's report on the scientific results of the Polaris Expedition. This will make two quarto volumes, with an abundance of illustrations.

— The summer school of Zoölogy of the Johns Hopkins University, Dr. S. F. Clarke, Director, opened in July, near the mouth of Chesapeake bay, for a session of six weeks. This need not be confounded with the laboratory established by Dr. Brooks at Beaufort, N. C.

— The Permanent Exposition of Philadelphia gave an entertainment on the 5th of July, in which about 30,000 persons participated. It netted about $7000, most of which, we understand, is to be devoted to the uses of the Natural History Departments.

— The American Association for the Advancement of Science will open at Boston, August 25th. The attendance will undoubtedly be large, and the meeting one of unusual interest.

— Prof. D. T. Ansted, an industrious geological writer, author among other books of a Physical Geography, died May 13. He was born in 1814.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

Journal of the Royal Microscopical Society.—June. On a parasitic sponge of the order Calcarea by P. M. Duncan. The genus Ravenelia, by M. C. Cooke. On the double and treble staining of animal tissues for microscopical investigations, by H. Gibbes. On the illumination of objects under the higher powers of the microscope, by J. Smith. The record of current researches relating to invertebrate animals, cryptogamous plants and microscopy are full and most useful.

Journal of Conchology.—January. This number, just received, contains but one article, a catalogue of the Polynesian Mitridæ, with remarks on their geographical range, station, and descriptions of supposed new species, by A. Garrett.

American Entomologist.—June and July. Contains notices of the white grub fungus, and an article on the true and bogus Yucca moth, with remarks on the pollination of Yucca, by C. V. Riley, while the July number gives a fully illustrated article on the method of pupation of certain butterflies, by the same.

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THE SIPHONOPHORES.

I.—THE ANATOMY AND DEVELOPMENT OF AGALMA.

BY J. WALTER FEWKES.

THE tubular jelly fishes present very interesting conditions of life, and so little has been written about them, except in special scientific memoirs, that a popular account of the anatomy and embryology of a few typical forms may be interesting to those who have not access to the literature. The scientific name of these animals is Siphonophoræ; they are all marine and found in almost every latitude, although most abundant in tropical oceans.

The best known example of the Siphonophoræ is by no means the best adapted to give a general idea of the structure of the order. The most common representative in our waters is called by sailors the "Portuguese man-of-war." Its scientific name is *Physalia*, and figures of it appear in almost every text book on zoölogy. The animal, however, is badly chosen to represent the order, for it is widely different in structure from the other tubular jelly fishes, and not only does not have a tube-like body, the characteristic which has suggested the name of the order, but also its anatomy and development, as far as known, are both abnormal and present many difficulties to one who wishes a knowledge of those jelly fishes with which it has a kinship.

If one should be asked to choose the genus best calculated to give a good idea of a tubular jelly fish, I think he would find one of the Agalmidæ the best choice. Two genera belonging to this

family are found in our waters; these genera may be known as *Agalma*[1] and *Agalmopsis*.

A popular description of the latter of these animals was given by Mrs. Agassiz in the well-known "Seaside Studies in Natural History" under the name of *Nanomia*.[2]

The present article will be devoted to the anatomy of *Agalma*, as I consider it the most typical representative of the tubular jelly fishes which have a float. I hope to follow this paper with another on the embryology of the same genus. Both articles are outline sketches of the subjects of which they treat.

The word *Agalma* is of Greek derivation, and means simply an ornament. No doubt Eschscholtz, the pioneer in the study of jelly fishes had in mind an ornament for the neck when he gave this name to the animal. As it gracefully floats in the water with its long pendant tentacles hanging behind it, the likeness to a living necklace with rosy band and transparent beads is very great. It also resembles closely a long, transparent, crystalline prism through which passes a highly colored thread resembling a longitudinal axis, such as is often found in glass models of crystals used in the study of mineralogy.

It will be found immediately, if one tries to raise the *Agalma* out of the water by the hand, that the prism is not a simple crystalline body, but is formed of members which are joined together in such a fragile manner that an attempt of this kind detaches all the component parts, and the beautiful crystal falls back into its native element broken into a hundred fragments. The parts thus detached are commonly known as individuals, and the whole prism as a colony. The individuals or pieces which compose the colony are extremely transparent, so that one can with difficulty follow by means of the eye their bounding lines, and often times to convince himself where the outline is, the sense of touch must supplement that of sight; even then one only becomes conscious that he has touched the animal when it shrinks away from the finger or contracts itself as if alarmed.

[1] Our *Agalma*, which I think is the same as Sars' *Agalmopsis elegans*, was discovered by me while at work in the laboratory of Mr. Alex. Agassiz at Newport. My reasons for considering *Nanomia* a synonym of *Agalmopsis* and not *Halistemma* or *Stephanomia* were given in a paper published in the Bulletin of the Museum of Comparative Zoölogy at Cambridge.

[2] *Nanomia* was first described by Mr. Alexander Agassiz. Proc. Boston So. Nat. Hist., IX, p. 181, 1863. See also North American Acalephæ, p. 200.

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best to place under it a deep glass jar and then allow the water to flow gently into the vessel, floating with it the unconscious *Agalma.* Confined in a jar with the light thrown upon it at a proper angle, the animal may be studied at leisure through the sides of the glass. The observer must not forget that he can seldom keep these fragile jelly fishes alive, in confinement, longer than a few days. At first sight the multiplicity of parts in the *Agalma* gives us a rather confused idea of the structure of the several members which go to make up the colony. A more attentive study will reveal the fact that many of the component parts are frequently duplicated, and that five or six characteristic forms include those of all the appendages to an axis or stem which seems at times to give support to hundreds of differently shaped parts. Many of the appendages seem to be very different from these typical members, from the fact that they are in undeveloped stages of growth.

The general characters of the appendages I will consider in sequence after a mention of that part which connects all the different members, viz: the axis or stem.

The Axis or Stem.—A study of the anatomy of *Agalma* leads us naturally to begin with the rosy-colored axis. To this structure the order of Siphonophoræ, to which *Agalma* belongs, owes its name. Passing through the colony from one end to the other, it connects all the individual members both physiologically and anatomically. Physiologically in the sense that to some of these members falls the task of eating for the whole, to others the function of propulsion, while to a single individual is delegated the duty of floating the whole community.[1] If those individuals which serve the function of propulsion are detached, the colony has only passive means of locomotion. If the eating individuals are cut off, the colony dies for want of nourishment. New individuals, however, are continually being developed from buds, so that it seldom happens, even when the stem is deprived of its members, that the colony suffers any fatal consequences.

The length of the stem in larger specimens, when extended, is about four feet, yet the animal is often contracted to half that length. The diameter is about that of a knitting needle, and is nearly uniform; a slight increase may be detected at either end.

[1] That which supports the animal in the water, and which is called the float, is considered by many naturalists a distinct individual. I regard it an organ and not an individual. My reasons will be given when I consider the development of this structure.

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BY J. WALTER FEWKES.

THE tubular jelly fishes present very interesting conditions of life, and so little has been written about them, except in special scientific memoirs, that a popular account of the anatomy and embryology of a few typical forms may be interesting to those who have not access to the literature. The scientific name of these animals is Siphonophoræ; they are all marine and found in almost every latitude, although most abundant in tropical oceans.

The best known example of the Siphonophoræ is by no means the best adapted to give a general idea of the structure of the order. The most common representative in our waters is called by sailors the "Portuguese man-of-war." Its scientific name is *Physalia*, and figures of it appear in almost every text book on zoölogy. The animal, however, is badly chosen to represent the order, for it is widely different in structure from the other tubular jelly fishes, and not only does not have a tube-like body, the characteristic which has suggested the name of the order, but also its anatomy and development, as far as known, are both abnormal and present many difficulties to one who wishes a knowledge of those jelly fishes with which it has a kinship.

If one should be asked to choose the genus best calculated to give a good idea of a tubular jelly fish, I think he would find one of the Agalmidæ the best choice. Two genera belonging to this

be seen in *Agalma*, but is not so well marked as in certain allied genera. Another suggestion for the homology of the float of *Agalma* is that it is a bud the same as certain of the other structures along the axis. This view was first published by Metschnikoff. I shall consider it at length when I speak of the development of this part.

The air sac in *Agalma* contains air or gas, and it opens into the cavity of the stem by an aperture opposite that into the surrounding water. The opening from the float into the water is surrounded by a sphincter muscle and dark crimson pigment spots of unknown function.

The Necto-calyxes.—The individual which performs the function of moving the colony through the water is called the necto-calyx or swimming bell. These are found occupying about one-third of the whole axis of the animal, and are arranged in two rows. They are transparent, bell-shaped and easily detached. Each row contains from ten to fifteen members. All the buds which later develop into necto-calyxes are grouped together in a botryoidal cluster just below the float. No necto-calyxes are developed from any part of the stem except this cluster of immature buds just under the float. The growth of an adult necto-calyx from a bud is very complicated, and there is no uniformity of opinion among naturalists as to its method.

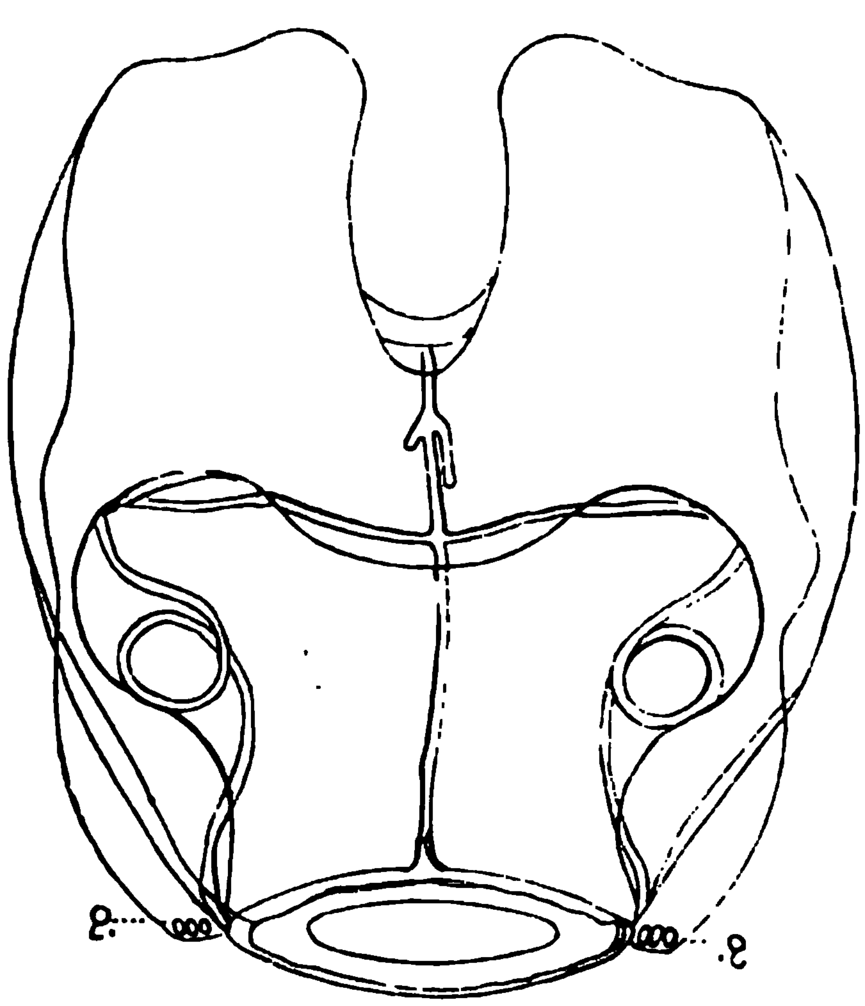

FIG. 2.—Necto-calyx.

A necto-calyx is simply the locomotive part of an ordinary hydroid Medusa. It is the bell, and the proboscis and tentacles are wanting, as would naturally be expected in consideration of their function.

Each necto-calyx is united to the stem at a point diametrically opposite the entrance into the cavity of the bell, and the approximating sides of consecutive necto-calyxes fit closely together.

Two opposite sides of the bell walls rise as horn-shaped projections which embrace the axis and fit closely into certain spaces left between similar projections on bells of the opposite series. By a dovetailed arrangement of this kind rigidity is given to both series, and loss of energy in muscular action reduced. The action of the bell is as follows: Water is taken into the cavity and by muscular contraction of the walls is violently returned through the opening by which it entered. The resistance which the water thus forced out encounters from the surrounding medium, determines the amount of motion given to the colony. The direction which the animal takes depends upon the angle which water passing out of the necto-calyx makes with the line of the axis. This final condition depends in turn upon the position of the mouth of the bell as referred to the stem, and is regulated by the animal. When, for instance, the openings of all the bells on one side are at right angles to the line of the stem, and water is forced through them, lateral motion is given to the animal. In such a case the muscular contraction of the walls of the bells in a series must be simultaneous. Solitary action of necto-calyxes at either end of the series would alter the inclination of the stem in the water. When the bell mouths point downwards, *i. e.*, towards the end of the axis opposite the float, resistance would be exerted at an angle less than a right angle, and as a consequence a motion in the direction of the axis is a result. Combinations in the action of different bells might be made to impart almost any motion to the colony. The motion in *Agalma* is seldom rapid but very graceful.

What has been said would seem to indicate the existence of a nervous system, but in *Agalma* no nervous elements have yet been made out satisfactorily. Pigment spots found on the rim of the necto-calyx may be regarded as organs of sense, but that they are such is only probable. *Agalma* is sensitive to the touch of the finger on almost any part of the body.

Nourishment is brought to a swimming bell by means of the stem, and is distributed in the bell by what are known as the chymiferous tubes. These are radially situated and are four in number, to which may be added a tube running around the rim of the bell, and a medially placed vessel which unites the radial system with the stem cavity.

In the earlier conditions of the necto-calyx the four radial tubes resemble each other very closely, and are straight vessels

passing from a common junction directly to a circular tube. In the fully grown bell, however, two of these tubes diametrically opposite differ considerably from the other pair, and take, in their course from common junction to the rim of the necto-calyx, a peculiar turn or twist which I have represented in my drawing. At their junction with the "circular tube" in the rim of the bell lie two or three large lasso or stinging cells, which do not appear in a corresponding position in the other tubes; these cells have been regarded by some naturalists as the remnants of tentacles which never are found fully developed on the necto-calyxes. The portions of the bell in which the tubes with an abnormal course lie, are the same which send out the projections embracing the axis, and interlocking in the dovetailed manner I have described above.

I should not regard even a popular account of the necto-calyx complete, if it did not include a mention of two tubes ending blindly in the substance of the bell; these arise from the medial tube connecting the radial system with the stem cavity, and are known as the "mantle vessels." They lie in the same plane as those two radial tubes which do not have any variation in their direct course to the circular vessel. One of these tubes may be the same as the tubular cavity of the covering scale. Many naturalists have supposed that the structure last mentioned corresponds with one of the radial tubes of a swimming bell. I think that homology not a good one, but I consider the cavity of the covering scale is homologous with one of the "mantle tubes."

The necto-calyxes never voluntarily separate from the stem, but when by any mishap they are broken off, they still retain power of motion and move aimlessly about in irregular circles, keeping up muscular action for a considerable time. Their independent life, however, is very short, for since they are separated from the axis no nourishment can be supplied them. They are locomotive in their function, but rely upon the fluid which circulates in the stem for their support. When such is not supplied them they die.

c. The Covering Scale.—All of the stem except that upon which the necto-calyxes are fastened, is protected, in *Agalma*, by structures known as covering scales or bracts. The German designation of these parts "*Deckstücke*," is used by some English and American naturalists. The covering scales are gelatinous,

resembling in that respect the necto-calyxes, and are so closely approximated, as to overlap each other and apparently to form a single unjointed prism. They have an irregular triangular outline, and a flat leaf-like shape. In *Agalma* they seem to serve simply the function of protecting the structure beneath them. They are traversed throughout by a medially placed canal or tube, which terminates blindly at the distal end, and opens at the other extremity into the cavity of the stem. The junction with the stem is by means of a pedicel, which is appended to one angle of the bract and has muscular fibers on its under side.

At the very tip of the covering scale there is a cluster of cells which have been supposed to indicate the homologies of the scale with a portion of the necto-calyx. These cells are looked upon as rudimentary tentacles, and are relatively much larger in the young scale than in the adult.

Agalma has, in addition to those described, two kinds of covering scales, which are embryonic and provisional. These will be mentioned under the embryology, for they are confined to early stages in the development of the animal.

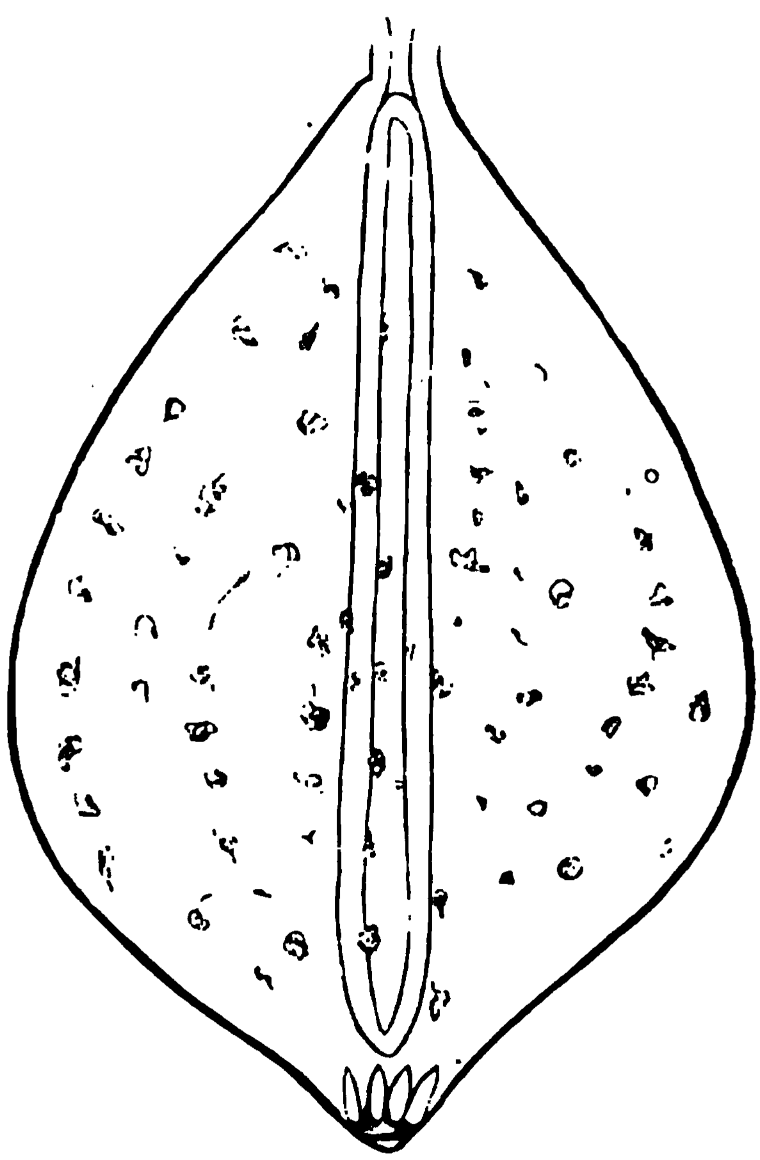

FIG. 3.—Covering scale.

The feeding polyps which lie under the covering scales and which are protected by these modified medusa bells, next claim a description. They are known as the polypites.

d. Polypites.—Certain flask-shaped bodies, more highly colored than those yet described, are appended to the polyp-stem, and their distal extremities extend out between the covering scales. They are supposed to be stomachs and to eat for the whole colony. A mouth at one end takes the food, hepatic cells arranged in rows along the inside of the polyp assist to digest it, and after being digested the nutritive fluid is passed into the stem cavity through which it is distributed to every member of the community. From the base of the polypite on the upper side arise the tentacle

and tentacular knobs. The tentacle is jointed, very contractile, and histologically differs in no respect from the stem. Each tentacle can be drawn up to the base of its polypite, where it may be snugly packed away under a protecting scale, or it can be extended and allowed to project beyond the body of the *Agalma* to the distance of a foot or a foot and a-half. When thus extended the tentacular knobs are best seen and studied.

c. The Tentacular Knobs.—Each genus of the tubular jelly fishes seems to have a characteristic tentacular knob. *Agalma* is not an exception. Although in the adult appended to the tentacle, they begin their growth from the ciliated base of the polypite, and do not bud from the tentacle itself. New buds which are to develop into tentacular knobs, are continually forming on the feeding polyp, and as the tentacle grows are being continually pushed out on its walls. In the earliest history of the growth of the knob, even before the polypite on which it is borne is fully developed, we find it with others in a cluster, partially coiled up at the base of the polypite. At that time there is no tentacle, but simply a cluster of partially coiled undeveloped tentacular knobs. In such a condition they might easily be mistaken for a wholly different kind of knob from the adult, and the polyps to which they are joined might be looked upon as a different kind of polypite. I believe them only undeveloped forms of the true polypite with tentacular knobs.

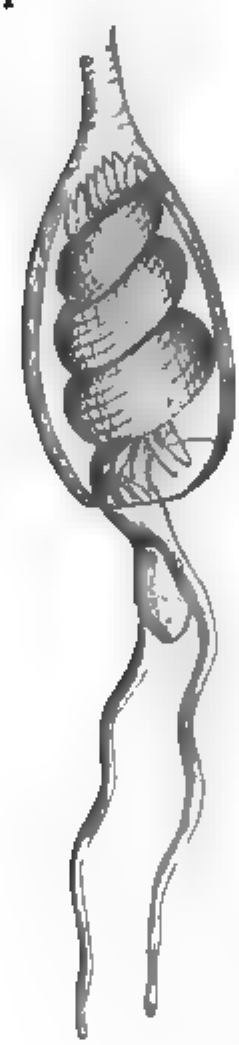

FIG. 4.—Tentacular knob.

In general outline the adult tentacular knob preserves a likeness to a Medusa. One portion of it may be likened to a bell and another to a proboscis. The bell is represented by an envelope surrounding the knob, and we might find the homologue of the proboscis in the coiled structure within this envelope. The bell portion is called the involucrum; the coiled proboscis, the sacculus. The sacculus is of dark crimson color, and ends in two filaments, or threads, and a sac supposed to be contracti e. The sac lies between the two filaments at their point of junction with the sacculus. It has been called a food reservoir, or "*Saft-behälter.*" This last term has been also applied to other structures in the *Agalma*.

According to Keferstein and Ehlers, the tentacular knob of

Agalma is still more complicated. According to these naturalists there are two elastic bands or threads, which arise from the inside of the involucrum and are fastened to the extremity of the coiled sacculus. Their figures of a knob where the sacculus has been uncoiled, show these bands very plainly. When the sacculus is withdrawn into the involucrum it is wound around a style which passes directly from the fundus of the involucrum to the contractile sac. I have seen portions of the elastic bands, and figure them in my drawing. Provisional embryonic knobs exist in larval stages: they will be described later.

f. The Tasters.—The word taster,[1] by which organs now to be described have been designated by the Germans, is one of the best which has been suggested. The tasters have also been called "hydrocysts" and "*Saft-behältern.*" These bodies are easily to be mistaken for undeveloped feeding polyps, but a more intimate study of them shows the error of so doing. They differ from the adult polypite in that they have no mouth, are destitute of hepatic cells, and their tentacles have no tentacular knobs. They never, in *Agalma*, drop off, and it is extremely doubtful that they ever separate from the colony and form new communities similar to those from which they are themselves buds. Large lasso cells are sometimes found near their base, at the proximal end, one of which was erroneously mistaken for a float. Claus has made some very beautiful researches on the histology of the taster. I believe the taster is homologous to a polypite, and that its function has, in certain respects, changed its form.

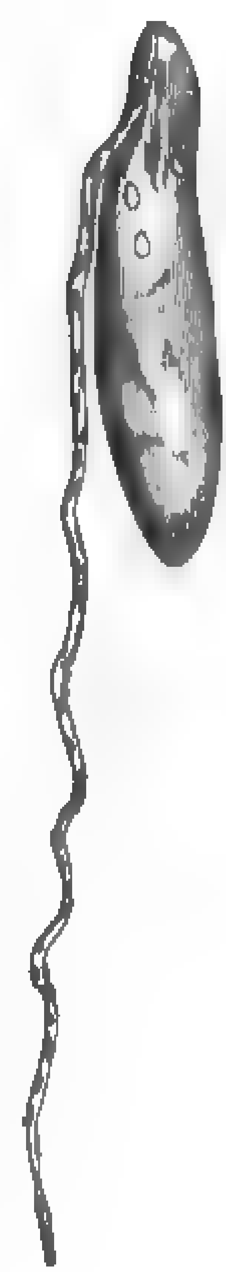
FIG. 5.—Taster.

g. The Sexual Bells.—There remains yet to be mentioned the sexual members of the "colony."

They assume the most perfect medusa form, and are found in clusters along the whole polyp stem. *Agalma* is monœcious; the male and female bells are separated from each other on the same stem, and arise on special pedicels from the axis. The female bells form botryoidal clusters and lie about midway between two polypites, but are never joined to the tasters as in some other genera. Each

[1] From "*tasten*," to touch.

female bell carries one egg, which will be described in the next article. Its growth and development will be found in the same place. The eggs are dropped in the water and there fertilized. Male and female bells ripen their products at different times. When the egg has left the animal, the sexual bell shrinks up on the stem and is finally absorbed or dropped; a scar on the stem alone tells of its former existence.

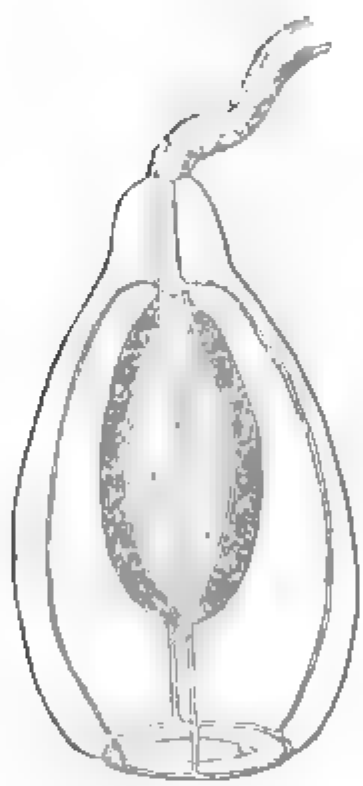

FIG. 6.—Male bell.

The male bells have more elongated pedicels than the female, but in both cases the sexual products are borne on the proboscis between the ectoderm, or superficial layers, and the endoderm. They probably originate from the intermediate layers, or mesoderm (?).

Agalma becomes sexually mature while yet retaining embryonic features. A young form of the most common species in the Mediterranean (*Agalma sarsii*) has been called another animal (*Agalma clavatum*). It is, however, only an immature form arrived at sexual maturity. I believe *Nanonia cara* is the sexually mature young of the genus *Agalmopsis*. *Nanomia* was found at Newport and Nahant.

A few theoretical questions suggest themselves after this fragmentary account of the anatomy of *Agalma*. The first question which arises is, to what great groups in the animal kingdom is it allied? From the study of the anatomy naturalists were led to believe that *Agalma* was a free swimming hydroid. This theory was simultaneously and independently brought out twenty years ago by several naturalists. The Siphonophoræ were regarded as hydroids which instead of being fastened to the bottom of the ocean, were detached or free swimming, and the point of attachment of the fixed form was supposed to be represented in a float to support the animal in the water. Many bitter personalities, happily now forgotten, were indulged in by those who claimed to have originated the theory, and it was defended with great zeal by its advocates. Embryology teaches another answer to the question of what *Agalma* is, and it is my purpose to speak of that answer after a consideration of the development of the animal.

Another question no less significant than the first is, as to how we know that the different appendages along the axis are individuals and not organs. Why not look upon them simply as organs? To answer this question we get some light from a study of animals allied to *Agalma.* There are tubular jelly fishes in which the appendages to the stem are not so numerous as in *Agalma*, and where there are clusters of appendages at intervals along the stem. Each one of these clusters, however, is composed of all essential members to fit it to lead a separated existence. We have in each a necto-calyx, a covering scale, feeding polyps with tentacle, and sexual organs. These clusters are bound together by the stem, and at a certain age in the life of the colony the stem breaks midway between two clusters, which swim about as separated individuals which live long enough to change their general form. In these genera we certainly have a composite animal composed of smaller clusters, each one of which is a colony. In *Agalma* that fact is masked, since the different component parts are pressed so closely together on the axis, but it seems none the less certain that the *Agalma* is composite. If we take the different parts which compose one of these colonies, many of which joined together form the *Agalma*, we find a resemblance to a typical hydroid medusa in each of its component parts. In the necto-calyx we have a hydroid medusa where tentacles and proboscis are wanting; in the sexual bells we find the same likeness where bell and proboscis are present and tentacles fail. The covering scale, polypite and tentacle together make up another, and so on. All closely resemble a common type of hydroid medusa. Embryology will shed much light upon this question, which I shall again discuss.

From what the anatomy of *Agalma* teaches, we may conclude that we have in this animal the following polymorphic individuals whose homologous parts "*inter se*" and with a common *Lizzia* are given below:

LIZZIA,	Bell.	Tubes of the bell.	Proboscis.	Tentacles.	
AGALMA,					
1st individual,	Float.	————————	Stem.	————————	
2d "	Necto-calyx.	Present.	————————	——repres'd by lasso cells	(*b.*)
3d "	Covering scale.	Cavity of scale.	Polypite.	Tentacles.	(*c.d.*) (*e.*)
4th "	Covering scale.	Cavity of scale.	Taster.	Thread-like tentacles	(*c.f.*) (*e.*)
5th "	Bell.	Present.	Proboscis with ova.	————————	(*g.*)
6th "	Bell.	Present.	Proboscis with sperm.	————————	(*g.*)
Doubtfully I add to those given					
7th individual,	Involucrum.	————————	Sacculus.	————————	

The first individual is never duplicated; the remaining a

numerous along the stem. A dash shows that the organs of the typical medusa are wanting.

It will be seen that I do not homologize the stem of *Agalma* with the stem of a fixed hydroid, but with the proboscis of a medusa. The Siphonophoræ are not free swimming hydroids, but medusæ with polymorphic individuals budding from it similarly to the condition in *Lizzia*. These buds are not zoöids but physiological and morphological individuals. I cannot follow Leuckart when he considers, however, that every bud is an individual. Three buds, the scale, the polypite and the tentacle together make one individual. Upon this subject we must look to embryology for light.

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DESTRUCTION OF OBNOXIOUS INSECTS BY MEANS OF FUNGOID GROWTHS.

BY PROF. A. N. PRENTISS.

[*Concluded.*]

Experiment No. 3.—May 10—A calla lily has become infested with aphides and red spider. The whole plant is carefully washed with a sponge except a small spot on one leaf where twenty-seven aphides are left, and a similar spot on another leaf where about twenty red spiders are left. The whole plant is sprinkled with domestic yeast, care being taken to thoroughly drench both the aphides and red spiders. The plant is covered by a bell jar which rests upon a ring of cotton batting, so as to shut the plant off from the approach of insects or spores from without, and prevent the escape of those within. Under the bell jar are placed two cups of actively fermenting yeast.

May 14.—The plant carefully examined. No dead aphides to be found. A number of cast-off skins are seen. The aphides are well scattered over the plant, but more than the original twenty-seven can be counted. The red spiders are also scattered so that the number cannot be ascertained. Several living but no dead ones are seen. That the spiders should have decreased in numbers might be expected from the moisture of the yeast independent of the Torulæ.

Experiment No. 4.—April 8.—Selected a thrifty rose geranium, about ten inches high, that had by count seventy aphides upon it, collected mainly upon the tender shoots.

The yeast is prepared by dropping pieces of compressed yeast-cake, bought at the grocer's, into Pasteur's fluid with sugar. In

about twenty-four hours the yeast has become active as is shown by frothing and the budding of the Torulæ observed under the microscope. This active yeast is sprinkled all over the plant, care being taken to wet the bodies of as many aphides as possible. Over the plant is placed a bell jar to isolate it from others.

April 11.—No effects noticed. Sowed more of the same yeast.

April 18.—The soil in the flower-pot has been allowed to become quite dry. The larger leaves of the plant have turned yellow, and upon these are nearly all the aphides. Counting as carefully as possible, the number is found to be three hundred and fourteen. The glass cover is removed and nearly all the aphides are brushed off, and the plant allowed a few days to recuperate.

Experiment No. 5.—May 1.—Sowed yeast procured direct from the bakery upon the same plant as in No. 4. Upon the plant are fifty-five aphides, mostly small. The plant is placed in a close Wardian case where there is an abundance of moisture.

May 6.—A mold (Mucor) has made its appearance upon all parts where the yeast adheres. The aphides are nearly all dead or dying. One aphis is found alive held to the stem of the plant by a pasty mass of yeast.

May 16.—Only three aphides alive; the mold has seriously injured the plant.

Experiment No. 6.—May 26.—Sowed yeast from the same bakery as in No. 5 upon the aphides on a healthy young plant of same kind and size as No. 4. This time the plant was not treated differently from others in the same room except being thoroughly sprinkled with yeast.

June 3.—Aphides as numerous as ever. No dead ones seen.

Experiment No. 7.—To ascertain whether any fungoid growths could be developed from the dead aphides in No. 5, two of them are placed on a bit of clean, broken plant crock sufficiently moistened, which is covered with a small bell glass, the rim of which rests in a shallow vessel of water to isolate the experiment as completely as possible. The experiment commences May 5, at 2 P. M. On May 6, at 3.30 P. M., some mycelium is visible on the body of an aphis.

May 9.—A number of upright hyphæ have fruited; the quantity of fruit is very small and not sufficient to determine what the mold is with certainty, but it appears to be a Mucor.

Experiment No. 8.—This experiment is introduced as a test of No. 7.

May 11.—Two aphides are taken from a plant which has been treated with yeast. One is dead when found, the other is killed; both are placed as in No. 7. No mycelium or fungoid growth of any kind is developed in this experiment.

Experiment No. 9.—This experiment was introduced for the same purpose as No. 8.

May 11.—5.30 P. M. Three living aphides are taken from a plant not treated with yeast, and killed and placed as in No. 7.

May 13.—The room has been quite cool and no mycelium has appeared.

May 15.—On one of the aphides a few fruits of a mold can be discerned. None can be seen on the other two.

This experiment seems to show that the mold developed in experiment No. 7 on the body of the aphis which had died, has no connection with the fact that the plant from which the dead aphis was taken, had been treated with yeast.

The result of these experiments, as a whole, as also many others not here recorded which have a more or less direct bearing upon the subject under consideration, indicate plainly that yeast cannot be regarded as a reliable remedy against such insects as commonly affect plants cultivated in greenhouses, rooms and parlors. Moreover, it is more than probable that the yeast would injure many kinds of plants, especially those with delicate foliage by spotting and soiling the leaves, and inducing fungoid growths upon the jars or soil in which the plants are grown. Indeed, in most greenhouses at the present time, it is not so much a question of keeping down injurious insects, as it is the suppression of molds and mildews of various kinds. The verbena rust only need be named as an illustration of this point.

Nearly all recorded experiments with the yeast fungus as an insecticide, have been attended only by negative results. Among these may be mentioned those of Prof. J. H. Comstock, of the Department of Agriculture, who fed caterpillars in breeding cages with leaves wet with dilute yeast. They seemed to thrive as well as others not thus fed.

Mr. Wm. Trelease tried last August a number of experiments with yeast upon the cotton-worm, in the vicinity of Selma, Ala.[1]

These experiments were varied and carefully conducted. In

[1] "Report upon Cotton Insects." J. H. Com[illegible] Dept. of Agr. Washington, 1879.

some cases the cotton plants upon which the worms were feeding were thoroughly drenched with active yeast. In one instance a number of the larvæ were placed in a tin box and drenched for twenty-four hours with yeast; after this the surplus yeast was drained off and the larvæ kept in the same box and fed for a week without showing any symptoms of disease. They were then sent to the department at Washington, where they arrived safely, and never gave those receiving them cause to suppose that they had been thus treated. Similar results attended all the experiments tried by Mr. Trelease, and he was led to the conclusion that the proposed remedy could not be utilized for the destruction of the cotton caterpillar.

On the other hand, Dr. Hagen mentions some experiments made last summer by Mr. J. H. Burns, of Shelter Island, N. Y., on the potato beetle, as being successful. A quantity of beetles was divided into two parcels, one of which was sprinkled on successive days with dilute yeast.

On the eighth day those sprinkled began to die, and on the thirteenth all were dead. Of the unsprinkled parcel only a few had died. That this experiment is decisive can hardly be claimed, as it is probable that some other substance, as for instance, dilute flour paste, which would favor the growth of fungi, might have had the same effect as the yeast. At all events, the experiment must necessarily be tried upon the beetles as they are found in their natural state infesting the potato plants, before any definite conclusion can be drawn.

It is true that Dr. Hagen found spores in quantity in the large sinus of the wing of the dead beetles which had been sprinkled, but it does not appear that these were in any way directly connected with the Torulæ of the yeast. It should also be noted that Dr. Hagen states in the May number of the Canadian Entomologist, for 1880, that he has recently received a letter from Germany, giving an account of the use of the diluted (compressed) yeast upon aphides in a green-house, "which was successful to an exceeding degree;" but no details in regard to the experiment are given.

Possibly the kind of yeast used may make a great difference in the result, although it should be remembered that three different kinds have been used in the experiments detailed in this paper.

It is also worthy of note that yeast, as suggested by Prof.

Metschnikoff, might in some cases prove destructive to insects to which it had been applied, not because of the yeast itself, but because of impurities which it might contain, it being an established fact that yeast may and often does contain the living spores of more than one kind of fungus.[1]

One of the things which is always taken into account in the cultivation of fungi in the laboratory, is the fact that when we purposely sow the spores of a given fungus we are never quite sure that we are not at the same time unconsciously sowing the spores of some other fungus which may be floating in the air. While we expect and generally obtain an abundant crop of the fungus we may wish to cultivate, we are apt to find here and there one or more other forms mingled with those we are trying especially to grow. These may be compared to the weeds which the gardener is pretty certain to find among the plants he has sown in his seed bed.

The subtle nature of fungoid growths of every grade, and the peculiar dependence of fungi upon climatic conditions and other circumstances, which are often unknown and wholly beyond control, are very important factors in estimating the probabilities of success by the methods under consideration. We know that epidemics and epizoötics of various kinds may be largely destructive and fatal one year, and the next, although the germs of disease must now be scattered in abundance everywhere, the disease is lessened or is wholly gone. Again, rust and smut may one season abruptly invade our grain-fields; the next it is scarcely seen; or blights and mildews may devastate for a few years our orchards and vineyards, and then gradually or suddenly disappear. Nor are these characteristics confined to microscopic fungi alone. During last season certain of the larger species, as Boletus and Hydnum, were sought in vain in localities about the University, where ordinarily they were abundant. The fall had been unusually dry and in this probably lay the cause of their non-appearance. Perhaps for the same reason, not a house-fly could be found that was affected with the Empusa, though they were sought for with much care, especially about the Botanical Laboratory where the yeast fungus was being grown.

Nevertheless, inasmuch as it is possible to suppress injurious fungi which destroy our economic insects, as for instance, the

[1] See *Nature* for March 11, 1880.

Muscardine in the case of the silk worm, the theory seems plausible that we may in time learn on the other hand, how to suppress injurious insects by fostering the growth of parasitic fungi which would spread infection among them and carry with it disease and death.

Finally, it must be confessed that the main question at issue is by no means decided, perhaps not seriously affected by the experiments and conclusions which I have here recorded. Though the yeast fungus may not be destructive to the insects named, and under the given conditions, it may, nevertheless, be destructive to other insects, or even to these under other conditions, or if the yeast fungus should prove to be wholly worthless and unreliable, it does not follow that there are not other forms which may be successfully employed as insecticides to the very great advantage of our most important national industry.

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LIST OF THE BIRDS OF THE WILLAMETTE VALLEY, OREGON.

BY O. B. JOHNSON.

[*Concluded from the July number.*]

40. *Poœcetes gramineus confinis* Bd. (Western grass finch).—Common during the summer, breeding extensively with the usual habits of the Eastern species.

41. *Chondestes grammicus* Say (lark finch).—Sparingly common during the summer, and breeding.

42. *Zonotrichia gambeli* Nutt. (Western white-crowned finch).—A very common summer resident, and nesting familiarly about gardens and thickets near dwellings.

43. *Zonotrichia coronata* Pall. (golden-crowned sparrow).—Sparingly common during summer and undoubtedly breeds, though I have not found its nest.

44. *Junco oregonus* Town. (Oregon snowbird).—Abundant during the winter and a few remaining to breed, the rest probably going to the mountains, where I hear of them. I have not yet seen its nest.

45. *Spizella socialis* Wil. (chipping sparrow).—A common summer resident, and breeding extensively with the usual habits of the species.

46. *Melospiza rufina* Bd. (rusty song sparrow). — A plentiful permanent resident, breeding commonly, and though I have found several nests with young, I have never seen its eggs.

47. *Passerella townsendi* Aud. (Townsend's fox sparrow).— Only a winter visitor; very shy and silent.

48. *Guiraca melanocephala* Swain. (black-headed grosbeak).— A common summer resident, breeding numerously.

49. *Cyanospiza amœna* Say (blue linnet).—An abundant songster during summer, and breeding plentifully.

50. *Pipilo oregonus* Bell (Oregon ground robin).—A common, constant resident, breeding numerously.

51. *Eremophila alpestris* Boie (horned lark).—An abundant summer visitor, nesting very commonly.

52. *Agelæus phœniceus* Linn. (swamp blackbird).—Very abundant in summer, breeding with the usual habits of the species.

53. *Agelæus gubernator* Wag. (red-shouldered blackbird). — Very abundant, with habits similar to the last.

54. *Sturnella neglecta* Aud. (Western field lark).—A constant resident, less common in winter; breeds.

55. *Icterus bullocki* Swain. (Western oriole).—Common in summer, breeding extensively.

56. *Scolecophagus cyanocephalus* Wag. (Brewer's blackbird).— Very abundant in summer, breeding numerously.

57. *Corvus carnivorus* Bart. (raven).—Not rare in the vicinity of Forest Grove; I have not seen its eggs.

58. *Corvus caurinus* Bd. (Western crow). — A common resident, breeding in communities.

59. *Picicorvus columbianus* Wil. (Clarke's crow).—Common in Cascade mountains, down to the foothills in winter. I have not seen its eggs.

60. *Pica hudsonica* Sab. (magpie).—Quite common in the vicinity of Forest Grove; it probably breeds, though I have not found its nest.

61. *Cyanura stelleri* Gmel. (Steller's jay).—An abundant resident, nesting in communities, at which time they are very silent.

62. *Cyanocitta californica* Vig. (California jay). — Common among deciduous trees, breeding about habitations.

63. *Perisoreus canadensis* Linn. (Canada jay). — Common in heavy timber in winter, probably breeds in mountains.

64. *Tyrannus verticalis* Say (Arkansas fly-catcher).—Common in summer, breeding in trees and about buildings.

65. *Sayornis nigricans* Swain. (black fly-catcher).—Saw a single example of this species in this place in July, 1879.

66. *Contopus borealis* Swain. (olive-sided fly-catcher).—Common in summer. I have not found its nest.

67. *Contopus richardsoni* Swain. (short-legged pewee).—Very common in summer, and breeds familiarly about orchards and houses; nest saddled upon a limb, composed of horsehair, strings and fine grass, and lined with cotton or wool; eggs usually three, sometimes four, cream-colored with dark-brown and lavender spots in a ring around the larger end. A set before me measure .66 by .54, .65 by .54, .65 by 53.

68. *Empidonax pusillus* Baird (little Western fly-catcher). — Quite common in summer, but I have not yet found its nest.

69. *Ceryle alcyon* Linn. (belted kingfisher).—Constant resident, breeds.

70. *Chordeiles popetue* Vieil. (night hawk).—Common in summer, breeding on gravely islands in the Willamette river.

71. *Chætura vauxi* Town. (Oregon swift).—I saw what I took to be this species in the Cascade mountains, in 1879.

72. *Selasphorus rufus* Gmel. (red-backed hummer).—A common summer resident, breeding; the only species observed.

73. *Coccygus americanus* Linn. (yellow-billed cuckoo).—Rare; I have seen two specimens killed in this vicinity.

74. *Picus harrisi* Aud. (Harris' woodpecker).—Common resident, breeding extensively.

75. *Picus gairdneri* Aud. (Gairdner's woodpecker).—Abundant, nesting in tops of dead willows.

76. *Sphyrapicus ruber* Gmel. (red-breasted woodpecker).—Not very common; I found a nest in a cottonwood "stub," about thirty feet from the ground, containing young.

77. *Hylotomus pileatus* Linn. (pileated woodpecker).—Common in heavily timbered districts. I have not seen its nest, but presume that it breeds in the "Great Burn" to the eastward.

78. *Melanerpes torquatus* Wil. (Lewis' woodpecker).—Common along the Columbia in winter, a few remaining to breed.

79. *Colaptes mexicanus* Swain. (red-shafted woodpecker). — Abundant, nesting commonly. I have seen twenty nests at once in the College buildings at Forest Grove, where they have cut holes through the frieze.

80. *Bubo virginianus* var. *pacificus* Cass (Pacific horned owl).—Quite common. I have not found its nest.

81. *Scops asio* Linn. (screech owl).—Very common, breeding in hollow trees.

82. *Syrnium cinereum* Gmel. (great gray owl).—Occasionally seen in heavily wooded districts.

83. *Nyctale acadica* Gmel. (acadian owl). — I have a single example that flew into an open transom at a jewelry store in this place.

84. *Glaucidium californicum* Sclat. (pigmy owl).—Quite common; I have not seen the nest. They are savage little fellows, and will attack cage birds in daylight, and I know of two that suffered death thereby.

85. *Nyctea nivea* Danel. (snowy owl).—Occasionally killed in winter by hunters in this vicinity.

86. *Aquila canadensis* Linn. (American golden eagle).—Occasionally killed by hunters in this vicinity.

87. *Haliaëtus leucocephalus* Linn. (white-headed eagle).—Common along the Columbia, nesting in high trees. I have seen them pick up young lambs as fast as they were dropped.

88. *Pandion carolinensis* Gmel. (fish hawk).—Common along the Columbia and Willamette rivers, nesting on trees.

89. *Falco sparverius* Linn. (sparrow hawk).—Very common, nesting in holes, usually of a woodpecker.

90. *Accipiter cooperi* Bon. (Cooper's hawk).—Occasionally seen.

91. *Accipiter mexicanus* Swain. (Mexican hawk). — I have a specimen that I refer to this species.

92. *Accipiter fuscus* Gmel. (sharp-shinned hawk).—Moderately common, nesting in hollow trees.

93. *Buteo montanus* Nutt. (Western red-tail hawk).—Common; I have not seen its nest.

94. *Buteo elegans* Cass. (elegant hawk).— A single example referable to this species.

95. *Circus hudsonicus* Linn. (marsh hawk).—Moderately common, breeding.

96. *Cathartes aura* Linn. (turkey buzzard).—Common during summer, sailing the air; have not seen its nest.

97. *Columba fasciata* Say (band-tailed pigeon).—An abundant summer resident, feeding chiefly on berries. They nest in various situations much like the common dove *(Z. carolinensis)*; I found

one of leaves and moss beside a tree, placed on the ground between two roots; another one upon an old stump that had been split and broken about eight feet from the ground; another was in the top of a fir (*A. grandis*), and was built of twigs laid upon the dense flat limb of the tree, about one hundred and eighty feet from the ground. These each had two eggs, pure white, and elliptical, differing from those of *Z. carolinensis* only in size; a set before me measure 1.60 by 1.20, 1.55 by 1.19. The first in my collection were obtained from the bodies of two females in 1877.

98. *Zenaidura carolinensis* Linn. (common dove).—An abundant summer resident, nesting commonly.

99. *Tetrao obscurus* Say (dusky grouse).—A common resident, breeding extensively.

100. *Bonasa sabini* Baird (Oregon grouse).—Very common along water courses, where it breeds.

101. *Ortyx virginiana* Linn. (Virginian partridge).—Introduced and doing finely.

102. *Oreortyx pictus* Doug. (plumed partridge).—Very common throughout Western Oregon, breeding extensively.

103. *Grus canadensis* Temm. (sand-hill crane).—Common during the migrations.

104. *Ardea herodias* L. (great blue heron).—A common resident, breeding in communities in tall trees.

105. *Botaurus minor* Bon. (bittern).—A common resident, breeds.

106. *Nyctiardea gardeni* Baird (night heron).—A single example, obtained May, 1876, near Salem.

107. *Ægialites vociferus* L. (killdeer).—A common resident, breeds.

108. *Squatarola helvetica* L. (black-bellied plover).—Occasionally shot during the migrations.

109. *Phalaropus hyperboreus* L. (Northern phalarope).—Occasional during the migrations.

110. *Gallinago wilsoni* Temm. (Wilson's snipe).—Abundant during the migrations, a few remaining to breed.

111. *Macrorhamphus griseus* Gmel. (gray snipe).—Occasional during the migrations.

112. *Tringa americana* Cass. (red-backed sandpiper).—Occasional during the migrations.

113. *Tringoides macularius* L. (spotted sandpiper).—Summer resident, breeding in favorite localities.

114. *Rallus virginianus* L. (Virginia rail).—Occasionally shot by sportsmen.

115. *Fulica americana* Gmel. (mud hen).—Common in winter along the Columbia river.

116. *Cygnus americanus* Sharp. (American swan).—Not rare during the migrations.

117. *Cygnus buccinator* Rich. (trumpet swan).—Common during the migrations.

118. *Anser hyperboreus* Pal. (snow goose).—Common during migrations.

119. *Anser gambeli* Hart. (white-fronted goose).—Common during migrations.

120. *Bernicla canadensis* Bon. (Canada goose).—Abundant during migrations.

121. *Bernicla hutchinsi* Bon. (Hutchin's goose).—Common during the migrations.

122. *Anas boscas* L. (mallard).—This and the eight following are abundant, during the migrations, along the Columbia and Willamette rivers and their tributaries.

123. *Dafila acuta* Jen. (springtail).

124. *Nettion carolinensis* (green-winged teal).

125. *Spatula clypeata* (spoonbill).

126. *Chaulelasmus streperus* L. (gadwall).

127. *Marcca americana* Gmel. (American widgeon).

128. *Aix sponsa* L. (wood duck).

129. *Fulix collaris* Dan. (ring-necked duck).

130. *Aythya americana* Eyt. (red head).

131. *Aythya vallisneria* Wil. (canvas-back).—Usually abundant during the month of February.

132. *Bucephala americana* Bon. (golden-eye).

133. *Bucephala albeola* L. (butter ball).—This and the preceding common during migrations.

134. *Mergus americanus* Cass. (sheldrake).—Common along water courses, a few remaining to breed.

135. *Mergus cucullatus* L. (hooded merganser).—Common during winter.

136. *Chrœcocephalus philadelphia* Ord. (Bonaparte's gull).—Driven into the interior by storms.

137. *Colymbus torquatus* Brün. (Northern diver).—Occasional along the rivers.

138. *Podiceps californicus* Her. (California grebe)—I saw an example that I referred to this species.

139. *Podiceps clarki* Lawr. (Clarke's grebe).—Occasional along the rivers.

140. *Podilymbus podiceps* L. (dabchick).—More common than the last.

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DO FLYING FISH FLY?

BY C. O. WHITMAN.

OF all the modes of animal locomotion, none has excited more general attention than that of flying creatures; and this is none the less so now that many of those who believe in the ultimate success of "the flying machine," have discarded the balloon theory, and come to regard nature's contrivances for flight as the true models for aërial locomotives. Among those animals that enjoy the much-envied power of flight, none has elicited such universal interest and comment, from old and young, layman and scientist, as that anomalous member of the finny tribe, the flying fish. Science, poetry and fable have conspired to extend the fame of this little denizen of tropical seas, and philosophy has more than once attempted to find some adequate cause for the enormous development of its pectoral limbs, hoping to find here one more important link between swimming and flying animals.

This fish owes its generic name to a curious belief which is said to have been current among the ancients. They supposed that the flying fish —"sea swallows" they called them—left the ocean at night and slept on shore, to avoid the attacks of their marine enemies. From this habit of "sleeping out," they were called *Exocœti*.

Besides Exocœtus, which includes between forty and fifty different species, there is a genus of flying fish called *Dactylopterus* (finger-winged), from the fact that the fin rays extend, finger-like, beyond the margin of the fins. This genus, popularly named the flying gurnard, is represented by comparatively few species which inhabit the Atlantic, the Mediterranean sea, the Indian ocean and archipelago, and the Japan seas.

To those who may never have had the opportunity to observe

the flight of these fishes, it may seem a matter of no little surprise that it is still an unsettled question whether they fly or skim. The difference of opinion on this point is all the more remarkable as the flying fish has been known, at least, since the time of Pliny, and even of Aristotle, and has always attracted the attention of voyagers. Although its aërial flight, to accomplish which it has to leave its native element, is not at all more remark able than the sub-aquatic flight of the quillemots, grebes, auks and penguins, all of which are accustomed to exchange temporarily their own element for that of the finny race, to move through the water with even greater rapidity than the fishes themselves, and to remain submerged longer than the flying fish remains above water; and although the modification of the fins for aërial locomotion is certainly not greater than that of the wings of the auks and penguins for flight under water; yet the testimony of able scientific witnesses, in favor of the actual flight of Exocœtus, has been often challenged by equally good observers, and plausible reasons have recently been urged against even the possibility of such flight.

It is maintained by many, perhaps the majority of observers, that the Exocœti are sustained by the parachute-like action of the pectoral fins, which they simply hold outstretched during their passage through the air. According to this view the fins exhibit none of that "poetry of motion" seen in the bird's wing, being capable of only a passive kite-like action, like the membrane-wings of the flying squirrel *(Pteromys)*, the flying lemur *(Galeopithecus)*, the marsupial Petaurists *(Petaurus* Shaw.) or the foot-web of the flying frog of Borneo.[1]

In one of our popular "natural histories" the flight of the flying fish is explained in the following manner: "These fishes possess the power of darting from the water into the air, and by the mingled force of the impetus with which they spring from the surface and the widely spread wing-like fins, to sustain themselves for a short space in the thinner element, and usurp for a time the privileges of the winged beings whose trackless path is through the air."

"The passage of this fish through the atmosphere can lay no just claim to the title of flight, for the creature does not flap the wing-like pectoral fins on which it is upborne."[2]

[1] Described by Wallace in his "Malay Archipelago."
[2] Wood's "Natural History."

The following statement to the same effect is found in "The Ocean World," by Louis Figuier: "Their fins sustain them rather as parachutes than wings."

In Beeton's "Dictionary of Natural History," the author speaks thus: "Although some few naturalists have supposed that these fish possess the true power of flying, that is, by beating the air with their members, it is generally agreed that their large fins sustain them parachute-wise when they have leapt from the water."

In the same place occurs a quotation from Bennett's "Wanderings in New South Wales," which is here given in full, as it contains some statements which have found quite general acceptance among scientific men.

Mr. Bennett says, "I have never been able to see any percussion of the pectoral fins during flight, and the greatest length of time that I have seen this fish on the fin has been thirty seconds by the watch; and the longest flight mentioned by Capt. Hall[1] is two hundred yards; but he thinks that subsequent observation has extended the space. The most usual height of flight, as seen above the surface of the water, is from two to three feet; but I have known them come on board a ship at a height of fourteen feet; and they have been well ascertained to have come into the channels of a man-of-war, which is considered as high as twenty feet and upwards. But it must not be supposed they have the power of elevating themselves after leaving their native element; for on watching them, I have often seen them fall much below the elevation at which they first rose from the water, but never in any one instance could I observe them rise from the height at which they first sprang; for I regard the elevation they take to depend on the power of the first spring or leap they make on leaving their native element."

Burmeister in his "Reise nach Brasilien" (Berlin, 1853, p. 36), declares that he watched the flying fish for a long time, and saw, with certainty, "that they made no kind of movement with their large pectoral fins, but held them quietly outspread like a parachute."

In his well-known work on "Animal Locomotion" (p. 98), Pettigrew says: "Whether the flying fish uses its greatly expanded pectoral fins as a bird its wings, or only as parachutes,

[1] "Lieutenant and Commander," by Capt. Basil Hall.

has not, so far as I am aware, been determined by actual observation. Most observers are of opinion that these singular creatures glide up the wind, and do not beat it after the manner of birds; so that their flight (or rather leap) is indicated by the arc of a circle, the sea supplying the chord."

From a careful examination of the structure and action of these fins, Pettigrew has been able to satisfy himself that "they act as true pinions within certain limits." That this restrictive phrase, "within certain limits," is intended to exclude a flapping motion, is evident from the following: "The flapping and gliding action of the wings constitute the difference between ordinary flight and that known as skimming or sailing flight. The flight of the flying fish is to be regarded rather as an example of the latter than the former, the fish transferring the velocity acquired by the vigorous lashing of its tail in the water to the air."

Pettigrew shows that all kinds of wings, when extended in flight, have a kite-like action, or a "combined parachute and wedge action" independent of any beating movement; and it is to this action alone that he refers when he says the pectorals "act as true pinions *within* certain limits."

According to Pettigrew, "Mr. Swainson, in crossing the line in 1816, zealously attempted to discover the true action of the fins in question; but the flight of the fish is so rapid that he utterly failed." So much for the negative testimony.

In favor of the flapping motion of these fins, we have the testimony of Capt. de Freminville,[1] who says, "I have been able to convince myself that they [flying fish] do actually fly, impressing upon their fins, which serve them as wings, a rapid movement—a species of vibration [frémissement]—which sustains them and causes them to advance through the air."

Speaking of these fish, which he saw on the way from Callao to Lima, U. de Tessan[2] says: "J'ai très-bien vu un poisson-volant battre d'abord des ailes en l'air, et puis les faire vibrer en planant."

In the "Reise der Oesterreichischen Fregatte *Novara* um die Erde" (1857–1859), published by Wüllerstorf-Urbair, 1861, p. 109, occurs (according to Möbius) the following: "Careful ob-

[1] *Ann. des Sci. Nat.*, Vol. XXI, p. 102, 1830.

[2] "Voyage autour du Monde sur la *Vénus*," Paris, 1844.

servation enables one to see that the wing-like pectoral fins of the flying fish are capable of a vibrating movement, like the wings of a grasshopper."

Dr. Kneeland[1] makes the following noteworthy statements as the result of observations made in 1870, on a voyage from San Francisco to Panama: "The ventrals were expanded like the pectorals in the act of flight. They rose out of a perfectly smooth sea, showing that they are not mere skippers from the top of one wave to another; they could be seen to change their course as well as to rise and fall, not unfrequently touching the longer, lower lobe of the tail to the surface, and again rising, as if they used the tail as a powerful spring. While the ventrals may have acted chiefly as a parachute, it seemed that the pectorals performed, by their almost imperceptible but rapid vibrations, the function of true flight."

To the same effect speaks A. v. Humboldt[2] when he says, "Notwithstanding the astonishing swiftness of their movement, one can convince oneself that the animal beats the air during its spring, *i. e., that it alternately opens and closes its pectoral fins.*"

In his work "On the Origin of Species" (p. 175), the great naturalist remarks: "It is conceivable that flying fish, which now glide far through the air, slightly rising and turning by the aid of their fluttering fins, might have been modified into perfectly winged animals. If this had been effected, who would have ever imagined that in an early transitional state they had been the inhabitants of the open ocean, and had used their incipient organs of flight exclusively, as far as we know, to escape being devoured by other fish?"

Without attempting to make this bibliographic sketch exhaustive—an infeasible undertaking with the libraries at my command —I will now pass to my own observations on the flight of flying fish, made during a voyage from San Francisco to Yokohama, on the steamer *City of Peking*, reserving till the last the consideration of the recent elaborate paper of Prof. Carl Möbius.[3]

Of the nearly twenty-three days that elapsed between departure and arrival (Aug. 1 to Aug. 24, 1879), at least ten were favorable for the study of the question under consideration.

[1] Proceed. Boston Soc. Nat. Hist., Vol. XIV, p. 138, 1872.

[2] "Reise in die Aequinoctial-Gegenden des neuen Continents," I, Stuttgart, 1815.

[3] "Die Bewegungen der fliegenden Fische durch die Luft." *Zeitschrift für Wissenschaftliche Zoologie*, Supplement to Vol. XXX, p. 343, 1878.

Aware that these fish are now generally regarded as skimmers rather than flyers, notwithstanding the testimony of very trustworthy observers to the contrary, I determined to satisfy myself, if possible, on this one important point.

I found the most favorable place for observation to be the bow of the steamer, and the best hours to be in the morning from five till eight or nine o'clock, and in the afternoon between three and six o'clock. Observations made when the air was quiet and the sea perfectly smooth, so that the fish could often be seen before they left the water, were the most satisfactory and conclusive. A stiff breeze, a billowy sea, a tossing ship and an easy chair are not conditions which facilitate accurate observation, and to such conditions, doubtless, is to be attributed the ill-success of many who have undertaken to decide this question.

It has often been stated, especially by those who deny the wing-like motion of the fins, that flying fish are seldom seen above water when the air is still, and Burmeister even goes so far as to say that "they fly *only* when there is considerable wind, since it is the wind which supports them."

That Burmeister "never saw a flying fish by still air," proves only his misfortune, either in having no opportunity to see, or in not improving the opportunities which he did have. I have often seen great numbers of these fish when the air was almost motionless—so still that not a ripple could be discerned on the glassy surface of the water—and it seemed to me that they were not much, if at all, less numerous on such occasions than when there was a moderate wind.

Under the favorable conditions before mentioned, it is by no means difficult to determine whether the fish executes any flapping movements with its pectoral fins. As I have seen them come out of the water directly under my eyes, I have been able to see distinctly the individual flaps of the large pectorals, while the ventrals were held in quiet expansion. The flapping movement, which is quite regular and rapid—so rapid that it is not easily recognized at any great distance until experience has sharpened the eye—may be continued for the whole, or a part of the flight; but is *generally* discontinued after the first few rods, and the course completed by a pure skimming or sailing movement. In some cases I have seen the flapping of the fins renewed once or twice after short intervals of the sailing movement. In

the case of young fish, from a-half to one and a-half inches in length, many of which I saw leave their native element to essay the rarer medium, the strokes of the fins are continued throughout the short flight; and the resemblance between these tiny fin-flyers and flying insects is most striking.

The course of the flight is generally in a straight or curved line; but on several occasions I have seen it abruptly changed, apparently by the aid of the tail, the lower lobe of which was brought for a moment into contact with the water.

In one instance I saw the course thus changed three times, at intervals of only a few seconds. The fish came out of the water only a few feet from the steamer, flew outward and backward, then, suddenly turning, came toward the steamer, striking the crest of a wave within a few feet of the same, it darted alongside, and again dipping its caudal lobe in the water, wheeled directly away from the boat and plunged into the ocean. In the majority of observed cases, where the tail was made to touch momentarily the water, the course was not changed, the tail appearing to act, as Dr. Kneeland has already remarked, like a spring for raising the fish.

In the case of a breeze, the direction of flight, as a rule, was either against that of the wind, or formed a more or less acute angle with it; not unfrequently, however, the flight is with the wind, or at right angles to it.

The longest flight observed lasted not less than forty seconds, and its extent was undoubtedly over eight hundred feet, and may have exceeded twelve hundred feet. This remarkably long flight began near the right side of the steamer and was performed in a long curve, which formed, at first, nearly a right angle with the boat, then moving directly against a gentle wind, but gradually turned backward, so as finally to coincide nearly with the direction of the wind.

While the average flight does not perhaps exceed fifteen seconds, nor extend above four or five hundred feet, yet I have observed numerous cases in which it was continued twenty to thirty seconds.

That this flight, executed in a horizontal plane, which, according to the concurrent testimony of all observers, is seldom raised above the surface of the water by more than two or three feet, continued for ten to thirty or forty seconds, and extending a dis-

tance of one to eight or more hundred feet, can be due to the impetus gained by a single spring combined with the parachute-like action of the fins, seems to me, aside from the oft repeated testimony of my eyes, quite incredible.

It is maintained, however, by Carl Möbius, professor in Kiel, in the article before mentioned, that the pectorals of the flying fish execute no flapping movement during flight; and this view is based not only on the author's observation of the flight of many Exocœti and one Dactylopterus, but also on anatomical and physiological grounds.

No one, so far as I know, has undertaken so elaborate a discussion of this question, and approached it from so many different standpoints as Prof. Möbius; and his conclusions will, on this very account, undoubtedly command the assent of many naturalists who have had no opportunity to settle the question for themselves. It is not, therefore, surprising to find that Prof. Bardeleben, in his review of this paper, in Hofman and Schwalbe's "Jahresberichte über die Fortschritte der Anatomie und Physiologie" (Vol. VII, part I, p. 129), appears to accept as conclusive the opinion so ably maintained by Prof. Möbius. Had I not seen many times, with my own eyes, under circumstances so favorable as to forbid all manner of doubt in my own mind, the flapping of these fins, I might have accepted the conclusions of the German naturalist and overlooked the assailable points of the arguments adduced in their support; but with the positive assurance that he is in error on the main question, I have been led to question the validity of some of his interpretations of facts. That I have fairly stated the position of this author in regard to the function of the pectoral fins of the flying fish, will appear evident from the following citations:

"If during the entire flight the pectoral fins of flying fishes actually made motions similar to those of the wings of bats, birds and insects, one would be able to perceive them quite as well as the strokes of equally large wings of bats and birds" (p. 353).

This statement is open to the objection that it entirely ignores the fact that the color of the fins, the rapidity and sweep of their vibrations have a vast deal to do with the question whether the fin-strokes would be as easily recognized as the wing-strokes of the bird or bat.

"Flapping movements of the large shining pectorals would

make themselves visible by the alternate appearance and disappearance of the light reflected from them. They would escape no accurate observer who viewed the fully expanded pectorals from the height of a steamer. But as often and as long as I have been able to follow with my eyes flying fish, which came out of the water near our boat, I have never seen light reflected in this manner from the pectoral fins as from the wings of birds and bats" (p. 353).

That these movements have escaped Carl Möbius is then evident from his own testimony; what application then is to be made of the statement that "they would escape no accurate observer?" This author first attempts to account for the fact that many good observers have affirmed the wing-like movement of the fins on historical and psycological grounds, asserting that this "false notion" had its origin in a fancied resemblance of these fishes to swallows, and that it has been handed down from the times of Aristotle and Pliny to the present time, simply on authority; and afterward, as if aware that this was not altogether a satisfactory solution of the question, admits that these observers may have had some grounds for their statements, but thinks they were deceived by appearances, which they did not understand, into the belief that the fins behave like wings. He is very frank in telling us just what these appearances are, although no one, not even Möbius himself, has ever observed such phenomena in a living Exocœtus.

"Just as a sail begins to slacken and vibrate the moment the wind blows parallel to its surface, so the more flexible and elastic distal and ventral parts of the pectoral fins are thrown into rapid vibrations when the air-current moves parallel to their surface" (p. 370).

As a simile, this will do very well, but how is it as a matter of fact? We are assured that this comparison is fully justified by the following simple experiment. A specimen of Exocœtus shriveled, distorted and stiffened by long soaking in alcohol, was suspended and its pectorals exposed to a swift current of air in such a manner that the current swept along both surfaces. The fins thus exposed "made directly under my eyes the same rapid quivering movement that various good observers of flying fish have regarded as a flying movement" (p. 370–371). It is important to observe that Möbius has here affirmed an identity without any authority whatever. He shows his deference to the statements of "good observers," by undertaking to sweep all their

testimony out of court by the mere breath of his private opinion. Surely this is a most facile mode of reconciling contradictory testimony!

If Möbius merely announces it as his *opinion* that the tremulous movement observed in his experiment is identical with the movement that has been so often interpreted as a true flying movement, then we have simply to raise objections.

There are three questions here to be considered: First, whether the fins probably exhibit such movement; second, whether such a movement, if made, would be probably recognized; and third, whether, if recognized, it would likely deceive "good observers."

It would seem that the wings of a sailing bird, such as a gull or a hawk, would be quite as likely to exhibit such motion as the fins of the flying fish; and it would be much more easily recognized in the former than in the latter.

With reference to this point, I watched the long-winged gulls that were seen almost every day of our voyage. These birds were often circling about the stern of the boat, on the watch for waste bits of food, and were remarkably good skimmers, moving the most of the time without flapping the wings. I very rarely saw any vibratory movement that could be attributed to the wind alone, and *never* anything of the kind that was of more than a momentary duration. It is very evident that, under conditions that would render possible a continuous movement of this kind, the bird, as well as the fish, would inevitably fall to the water.

Is it probable that a momentary quiver in the comparatively small fin-wings of a swiftly-moving flying fish would be noticed? The fact that no naturalist has ever affirmed anything of the kind except Möbius, who bases his assertion on an experiment with an alcoholic specimen, is sufficient answer to this question.

As to the probability of any one being deceived by such motion, I cannot, of course, judge from experience, as I have never been so fortunate as, in the first place, to detect it, and, in the second place, to discover that I had erroneously interpreted it. I cannot persuade myself, however, that any "good observer" would be likely to make such an egregious blunder.

That Möbius does not regard this hypothetical quivering as in any sense a true flying movement, he states in the most unequivocal manner, and goes on to ask, "how, then, are the Exocœti able, without touching the water, to rise over the waves? For

this also they make no fin-strokes. They do not raise themselves, but are passively raised by the ascending currents of air, which are caught in the grooves on the under surface of their pectoral fins" (p. 371). Notwithstanding the oft-repeated affirmation that flying fish do not actually fly, our author seems, in one place, to admit the possibility of the flapping of the fins during flight. "These explanations of the movement of the flying fish do not imply that an Exocœtus or a Dactylopterus cannot make powerful and plainly recognizable movements with its tail and pectorals during its ascent (out of the water), and even occasionally in the middle of its course, if prompted thereto by a strong wetting of the body by the waves" (p. 372).

This statement, interpreted in the light of the context, cannot be said, however, to involve a contradiction; the author simply means that the fins and tail may be used in getting out of the water, and that these movements may possibly be recognized just as the fish rises. But he still maintains that the wing-like movement attributed to them by many observers, "arises not through muscular action, but through the elasticity of the out-spread fins and the pressure of the air, which act alternately against each other" (353–354).

Passing on from these explanations, which presume to reconcile conflicting statements by pronouncing all that will not be reconciled, fallacious, and by substituting others of a less obstinate but of a purely hypothetic nature, which seem to admit of a quasi-explanation, we have next to notice the arguments urged from an anatomical and physiological standpoint.

"I believe then," says Möbius, "that I have refuted on anatomical and physiological grounds, the opinion that flying fish use the pectoral fins as wings" (p. 368).

In this entire discussion, Möbius tacitly assumes that there can be but two opinions on this question, namely: his own opinion, which he shares with many others, and the opinion attributed, with more or less justice, to A. v. Humboldt, Kneeland and others, *that the fins are flapped with great rapidity throughout the entire flight.* While the claim to have refuted the latter opinion seems altogether too pretentious, it may be freely admitted that the reasons adduced have much more force against it than against the view here maintained, that the flapping movement is *generally* continued for only a part of the flight.

The frequency of the fin-strokes is made the first point of attack. Referring to the number of revolutions made by the bird's wing per second, which, according to Marey,[1] are for the

Sparrow	13
Wild duck	9
Pigeon	8
Moor buzzard	5¾
Screech owl	5
Buzzard	3

Möbius remarks: "If flying fish make a still larger number of fin-strokes per second, then the fin-muscles must be able to contract even more rapidly than the pectoral muscles of birds and all other vertebrates." Then follows a comparison of the muscles of certain fishes with those of mammals, birds and frogs, in respect to the time required to execute a muscular contraction—all with a view to showing that the muscles of Exocœtus are incapable of making very rapid contractions. The strength of this argument is impaired by two facts; first, the duration of a muscular contraction has never been determined for Exocœtus; and second, the number of fin-strokes per second has never been estimated, much less experimentally ascertained.

Furthermore, it does not follow, as Möbius asserts, that if the flying fish make more than thirteen fin-strokes per second, its fin-muscles must be able to contract more rapidly than those of birds. That they would be more rapid than those of *some* birds under *some* circumstances, can be safely asserted, and nothing more. The number of revolutions made by the sparrow's wing in a second is greatly exceeded in the wing of the humming-bird; and the figure given by Marey does not represent the maximum number of strokes of which the sparrow's wing is capable. A complete "muscle-curve" consists of a "*latent period*," a *contraction* and a *relaxation*, as every tyro in physiology knows, and the last two phases may vary much in duration according to circumstances.

Again, the size of the fin-muscles is said to be incompatible with the theory that the fins execute true flight.

The average weight of the entire bird, as determined by Harting for thirteen birds belonging to different orders, is 6.22 times that of the pectoral muscles. In the case of Chiroptera, according to the Dutch physiologist, the body weighs 13.6 times

[1] "Animal Mechanism," p. 228.

as much as the pectoral muscles; and the relation between the same in Exocœtus was found, by Möbius, to be as 32.4:1.

If the work performed by the muscles of flight be proportional to the weight of the body, then, as Möbius observes, the pectoral fin-muscles of Exocœtus must develop about five times as much force as the pectoral muscles of birds, and about two and one-half times as much as the same muscles of the bats.

The objection from this point of view has been greatly over-estimated by Möbius. As flying fish generally move their pectorals during only a part of their flight, which is at most short, they do not need to expend so much muscular energy as birds and bats, which take long continued flights. Small muscles may perform, for a brief period, work which only larger muscles would be able to perform for a long time. Möbius seems to have overlooked the fact that *time*, as well as size, is an element of this problem.

Perhaps also the large air-bladder may, as Humboldt supposed, have something to do with lightening the work of the muscles, while serving as a store-house of oxygen.

The experiment of Humboldt, by which he determined that the fin-rays of Exocœtus move with five times greater force than the rays of other fins, would seem to favor the opinion here maintained.

Admitting that in form, size, length and structure the pectoral fins of Exocœtus are less well adapted to flight than the wings of most birds, there is still ample room to believe, on anatomical and physiological grounds alone, that they are capable of executing true flight.

In regard to the personal observations of Prof. Möbius, it may be said that they can lay no claim to the right of deciding this question. Whatever evidence they afford is of a purely negative character; and of this fact Prof. Möbius seems to be fully aware, if we may judge from the stress which he lays upon other considerations.

That Möbius and others may not have been fortunate enough to recognize the wing-like motion of the pectorals, establishes at most only a probability, which weighs very little against the positive evidence afforded by the testimony of those who have actually seen flying fish fly.

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The reasons why governments should foster scientific research, are simply those which render it important that the sciences should exist. We take those reasons to be as follows: Firstly, the importance of developing the rational part of the minds of the race coincidentally with progress in other directions. Scientific publications stimulate thought, both by adding to the materials of thought and by opening up new directions for its activity. At the foundation of scientific publication and its functions lies original research, which is the source of all knowledge. The relation of knowledge to the habit of rational thought is obvious. The importance of the rational habit of mind in the individual and in the nation, cannot be over-estimated. It affects the daily intercourse of men more than any other quality, since it is the essential element in morals and in personal viability.

Secondly, scientific research is essentially important in the light which it throws on our physical relations to our environment, and the command it gives us over the resources of the world in the amelioration and elevation of our physical condition. This, popularly spoken of as the primary mission of science, is nevertheless second in order of importance.

Thirdly, the cultivation of science is beneficial to the community in affording material for the pleasurable occupation of time, and through the interest which it evokes, in furnishing an antidote to ever mischievous idleness. Its attractions doubtless serve to divert the mind from activities of a character injurious both to the individual and to the community.

The encouragement and support of scientific research is then, evidently a duty of governments, as involving most important parts of the interests of their peoples. That this has been the opinion of most civilized nations is well known. The great scientific works of many of the European nations are among their chief glories.

The peculiar character of our own government offers an inviting field for the establishment of organizations for the development of knowledge through the aid of the National Treasury; and thanks to the energy of private citizens and others, a number of such organizations have already reflected great credit on our legislators, and have placed American scientific work on a plane with that of the old world. But our opportunity is also our danger.

It is easy to understand that access to the national resources is as open to place hunters as to scientific men, and that personal jealousies and private ambition may hope for easier successes than under any other form of government.

We allude to this subject for the purpose of pointing out two prominent instances of the introduction of demagoguery into scientific politics, so to speak, in the belief that unless "eternal vigilance" is exercised in this direction, scientific interests will undoubtedly lose that influence in the councils of the government, which has hitherto proven so beneficial to the progress of knowledge.

The sentiment has been propagated that our government should not foster scientific research, because it thus becomes "a crushing competitor" of private scientific enterprise.[1] While such an expression as this could not emanate from a scientific man, it might have some influence did not scientific men distinctly repudiate it. We are aware that it has been used with effect in some quarters, by persons who would like to be regarded as scientific men. We maintain that such a sentiment as the above, effectually settles their claim to such consideration. Such language would indeed be quite inexplicable had it not been accompanied by the additional assertion that Congress should employ scientific research for the development of the material resources of the country. This looks like an appeal to the cupidity of legislators in favor of certain kinds of science as against other kinds. If this be so, we believe that this is the first time in our history that any one has sought success for a scientific enterprise by such methods. The custom has been hitherto to appeal to material interests in justification of pure science; and to such a policy on the part of scientists are we indebted for most of our great government works on purely scientific subjects.

But the appearance of tampering with the interests of pure science has been still more evident in certain official documents issued not many months ago.[2] Specific objections have been made against certain departments by *soi disant* scientists who desire aid for their own specialties. A more short-sighted policy cannot well be conceived; for objections fairly lodged in the minds of Congressmen, can be turned in any direction with great facility. We suggest to our friends, whether all may not suffer alike through the short-sighted selfishness of persons who do not hesitate to push their supposed private interests by attempting to destroy existing institutions which are in the field before them. We ask whether there is not some risk that the government system of subsidies to science, which have been built up at the expense of much talent and toil, may be destroyed through the jealousies of a few unpatriotic persons calling themselves scientific men?

[1] See AM. NATURALIST, March, 1879.

[2] Report on the Methods of Surveying the Public Domain, Oct., 1

RECENT LITERATURE.

SOME RECENT PUBLICATIONS ON JAPANESE ARCHÆOLOGY.—Doubtless many readers of the NATURALIST may have seen a review in *Nature* of my memoir on the Shell Mounds of Omori, and in the same journal my reply and protest against the gross misrepresentations which that review contained. My reply was prefaced by an unexpected letter from Charles Darwin, in which he not only speaks of the "very scant justice" done to my work in the review, but compliments the Japanese for their part in the matter. This answer called forth a second letter of considerable length, for which *Nature* seemed to find ample room.

This second letter consisted mainly in extracts from a recent paper on Japanese archæology by Prof. John Milne. My reply to this consisted mainly in a review of Mr. Milne's paper, and on this ground alone the editor of *Nature* might have seen fit to publish it. My article was returned to me, however, as too long. As it is impossible to shorten it much, and as another publication on archæological subjects has recently appeared in Japan, which demands notice, a review of both papers may possibly bring out some features of interest to those studying these subjects.

It is hardly necessary to add that my only excuse for noticing the efforts of Mr. Dickins is, that his letters appear in one of the widest and best known journals of science.

It is difficult to see that Mr. Dickins has at all met the points I protested against in my first letter. In other words he not only did "very scant justice" to my memoir, to use Mr. Darwin's temperate words, but he showed a lamentable ignorance of the work he attempted to review. A single illustration will suffice.

In his first article he says: "These mounds consist for the most part of shells *little if at all distinguishable from what are still to be found in abundance* along the shores of the Gulf of Yedo." The italics are mine.

My memoir shows that the species composing the deposit are different in their form, size, proportion of parts and relative abundance from similar species living to-day, and that one of the most abundant shells in the mounds is not found nearer than four hundred miles to the south-west, while others are rarely found in the Gulf of Yedo.

Observe now the "spirit of truth" which Mr. Dickins says animated him in writing his review. Having suddenly discovered that somebody else offers a possible explanation of the cause of these changes, Mr. Dickins for the first time recognizes the fact of these differences by quotations which are taken from my memoir.

Mr. Dickins parades with evident exultation the paper of Prof. John Milne published in the Transactions of the Asiatic Society of Japan, and since of the three names Mr. Dickins mentioned, Prof. Milne is the only one that can lay any claim to having pub-

lished on the matter, a review of his paper becomes a disagreeable necessity. Let us see then if Prof. Milne's paper can be regarded in the light of a contribution to science.

This paper appears in the Transactions of the Asiatic Society of Japan, Vol. VIII, Part I. It is entitled "Notes on Stone Implements from Otaru and Hakodate, with a few general remarks on the Prehistoric Remains of Japan."

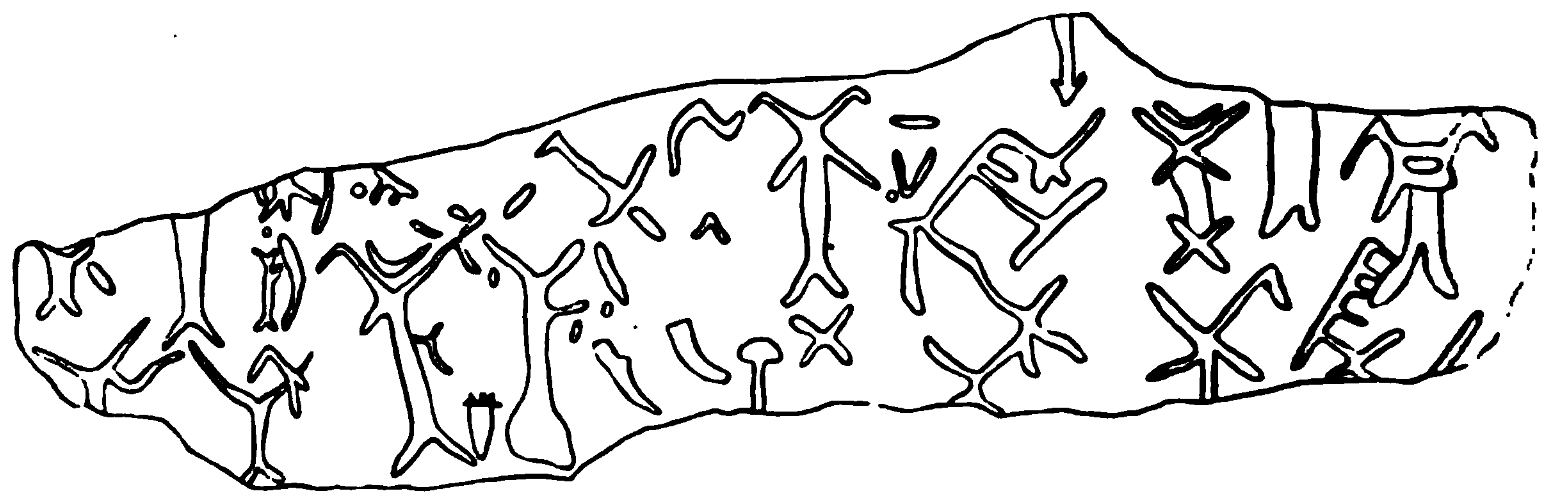
An idea may be formed of the loose way in which measurements are taken by the following. Speaking of certain stone implements he says: "These are *about* one inch long, having a curved scraping edge one inch broad." Again, "Its total length is *about* two and a-half inches, the pointed portion which is roughly rounded being *about* one and a-half inches." (The italics are mine.)

Zoölogists will hardly agree in an opinion advanced by Prof. Milne regarding the remarkable differences observed in the shells of the Omori mounds compared with recent forms. This opinion is that these changes have been induced by the upheaval of the shore, *during recent times* (the italics are his), and that as a result of this, of course one species has been driven four hundred miles further south! Also that the growing up of a few cities within the last few hundred years, may have so vitiated the waters of the gulf as to have helped change the appearance of these species *during recent times.* When it is considered that this body of water contains nearly a thousand square miles of surface, with changing tides, and that the populations which have been growing up have not been accompanied by chemical works, tanneries, slaughter houses and other manufactories which are among the chief agencies to vitiate the water, and furthermore that that portion which makes up the filthy sewerage in European cities is largely conveyed inland and emptied on the rice fields, the supposition of Prof. Milne becomes simply ridiculous. If convincing proof is wanted of the absurdity of this idea, an illustration is at hand in *Mya arenaria.* This species very quickly shows the impurity of the water, either from the admission of fresh water or from the water being cut off from ready access to the tides. The small and stunted specimens occurring in certain estuaries are examples. More curious illustrations may be seen in the stunted and distorted forms of this species which formerly occurred in the Loch of Stennis in Orkney, and in the sluices of Ostend. It was suggested by Forbes and Hanley that the singular varieties of *Mya arenaria*, known as *Mya lata* and *Mya pullus*, which occur in the mammaliferous crag of the east of England, may have been due to a freshening of the water at that time from melting ice. However that may be, *Mya arenaria*, by its diminishing size and abnormal growth, indicates the impurity of the water in which it lives. Fortunately *Mya arenaria*—the typical northern form—lives in the Gulf of Yedo to-day, and its shells are found in the

mounds of Omori. A comparison of the recent with the ancient forms show the least possible change, with the present form *slightly larger* and just as perfectly developed.

Prof. Milne will be called upon to give his authority for the statement that the Ainos have platycnemic tibiæ! Until some explanation is made, archæologists will please look to Prof. Milne as an authority for this remarkable statement. We may add, by the way, that Aino skeletons are such a drug in the market that there can be no difficulty in verifying this statement!

A most wretched and misleading cut is given of some rock inscriptions from Otaru. In order that the hieroglyphists may have some conception of the appearance of these curious inscriptions, we present a figure reduced from a drawing made by a Japanese gentleman, Mr. Morishima.



Rock Inscriptions from Otaru, west coast of Yezo. Scale 1-30.

In proof that the Ainos are pot makers, the following overwhelming evidence is given: "Mr. Charles Maries when traveling over Horidzume on the eastern coast of Yezo saw at the houses of the Ainos clay vessels *in appearance very like* the fragments obtained from the *shell heaps, and he believes* that the Ainos in that district still manufacture pots!" (The italics are mine.) In another sentence we are told that the Ainos have given up the art of pottery making since coming in contact with the Japanese, as they could purchase the ware cheaper than they could manufacture. Mr. Dickins has amused those familiar with Japanese faience by finding a resemblance between the shell heap pottery and Banko. Is it not more than likely that Mr. Maries has made a similar mistake. (I met this gentleman in Yezo, and found him a most delightful and entertaining acquaintance, but laying no more claim to a knowledge of these subjects than I do of the trees, the seeds of which he was sent out from England to collect.) I have also crossed Yezo from the west coast, have visited a great many Aino villages, examined a great many interiors and identified the pottery and lacquer used by the Ainos, and failed to find any evidence that they are to be regarded as pot makers in any sense of the word.

In the following manner does Prof. Milne suggest that the Ainos might have been cannibals. He finds in a number of old

books references to their cruel modes of punishments, and says: "There are many references given which show that the Ainos, a few hundred years before they were properly subdued, possessed a character which was sufficiently cruel to render it unnecessary to extend our imagination very far beyond the incidents which are there recorded, to see them practicing cannibalism." Extend our imagination! Very well, let us extend our imagination in the following case. In the records of the dreadful persecutions in Scotland two hundred years ago, persecutions so zealously maintained by that class who had the moral welfare of the people in charge; we read, among hundreds of accounts of the most atrocious tortures, of one "who remained in the same machine for eleven days and eleven nights, whose legs were broken daily for fourteen days in the boots, and who was so scourged that the whole skin was torn from the body." From this evidence, according to Prof. Milne, we are not even justified in extending our imagination far beyond this time to see the Scots practicing cannibalism!

In the following paragraph which is here quoted from Prof. Milne's paper, we must accuse the writer either of deliberate misrepresentation or of careless ignorance:

"Prof. Morse in describing the mounds of Omori, gives a list of the 'Objects not found at Omori.' About these we will make no remark. In these shell heaps, or scattered through the ground near them, stone implements are often found. *The number and nature of these* may be judged from the descriptions which I have given of the deposits at Hakodate and Otaru." (The italics are mine.)

We now turn to his description of the Otaru shell heaps, and find the following:

"In two visits to the place, entailing about six hours actual work, at which I was assisted by two coolies and about a dozen children, I made the following collection:" and this collection embraced one hundred and thirty-five arrow-heads, three scrapers, one awl, nine axes, one grinding stone and from three to four hundred obsidian flakes. Having also collected in the Otaru shell heaps, assisted by students, coolies and children, the yield of stone implements was quite as great.

It would be difficult to compute the number of hours actually spent in collecting in the Omori mounds, for a very great number of visits have been made to them in company with a large corps of students and assistants, and yet the entire yield was but eight rude stone implements, which have been figured in my memoir.

In other words, Prof. Milne, with assistants, collects from the Otaru mounds, in six hours time, one hundred and fifty-two stone implements, not counting hundreds of obsidian flakes. I with my assistants, in a large number of visits to the Omori mounds,

entailing perhaps five hundred hours work, have secured only eight rude stone implements!

Prof. Milne, therefore, stands accused of gross misrepresentation, to use no harsher term, for had he collected in the Omori mounds, or had he examined the collections at the University of Tokio, indeed had he taken the slightest pains to ascertain the truth in regard to the matter, he would have seen the wide difference in the number and character of the implements collected in the two places.

Judging from "the spirit of truth" which animated Mr. Dickins in the preparation of his article, it is no wonder he prefers such an authority to that of the "Salem Zoölogist," as he courteously designates the writer.

The above passages are sufficient to show the general character of this remarkable production. There is one portion of Prof. Milne's paper that is a valuable addition to our knowledge of the early people of Japan, and that portion, significantly enough, has been extracted from a recent work written by Mr. Kurokawa Mayori, for the translation and revision of which Prof. Milne has to thank the accomplished scholar, Ernest Satow!

We turn with relief from this paper to a work published by Henry von Siebold, from the press of M. Levy & Co., Yokohama. Mr. Siebold's work in quarto contains twenty-two pages of letter press, and is illustrated by twelve excellent photographic plates, crowded with figures of stone implements, stone ornaments and a few fragments of pottery. These will be of great interest to archæologists, and much credit is due Mr. Siebold for the manner and matter of his book. In short chapters he treats of stone implements and stone weapons, Japanese graves, Japanese caves, Japanese ancient pottery, Japanese shell heaps, stone ornaments and bronze objects, and tsuchi mugio or clay figures.

Many interesting facts are given under these various heads, and his work is an important contribution to the scanty knowledge we possess of the stone implements of Japan.

There are some criticisms to be made, however, and the first one is, that in his pages he does not give thanks to the numerous Japanese friends who have loaned or given him material to illustrate his work, and who have, in various ways, aided him in his researches. This marked omission is certainly one of ingratitude which hardly becomes a foreigner who is admitted to many of these treasures through the courtesy of the Japanese government. This omission becomes all the more glaring in a land where politeness and gratitude are universal characteristics of its people.

In mentioning localities Mr. Siebold is not explicit enough. It is not sufficient to speak of caves in the Province of Musashi, for Musashi is a large province and covers a great deal of ground. He probably refers to the caves at Kabutoyama in this case, but there is no indication of this in his work. The marked absence

of these references, in many cases, is a serious fault in a work of this nature.

Mr. Siebold makes a ludicrous blunder in the following statement: "The shell heaps themselves consist, as is likewise the case with the Kœkkenmœdding of Europe and other parts of the globe, of the *Eburna!*" Will Mr. Siebold kindly inform his readers in what shell heaps of Denmark, Norway, Sweden, Great Britain, Spain, France, Portugal, North and South America, either on the east or west coasts, a single shell of Eburna has ever been found? Mr. Siebold has unfortunately copied his molluscan information (without credit being given) from a little paper of mine in the *Popular Science Monthly.* Being in Japan when this paper was printed, it was impossible for me to correct proof, and a printer's blunder which ran two genera together, as follows, "Pecten Cardium," Mr. Siebold reproduces this blunder with remarkable accuracy, and at the same time mixes things in a most unaccountable manner, by scattering the genus Eburna all over the world!

A little attention in quoting from other contributions might have saved him some mortification in this case.

Mr. Siebold in his impatience to prove the Aino origin of all the shell heaps in Japan, is lead into some curious processes of reasoning. For example, a curious comma-shaped stone, known as a magatama, is widely scattered throughout Japan and is regarded by the Japanese as having a high antiquity. The absence of this object in the shell heaps leads Mr. Siebold into the following extraordinary mode of reasoning. He says, "It would be scarcely possible to expect to discover among these rude stone implements which these shell heaps have produced, such an artificial ornament as a magatama, especially as the shell heaps themselves were only used as receptacles for useless and valueless articles. I think, therefore, that the fact of the magatama not being found is, on the contrary, proof that the shell heaps are of Aino origin." Comment on such reasoning is unnecessary.

Mr. Siebold states that in only one deposit has the evidences of cannibalism been found. It will interest him to know that in the Tokio deposit, in the deposits of Okadaira as observed by Mr. Sasaki, and in the Higo deposits as observed by me, the most unquestionable evidences of cannibalism occur. Mr. Siebold can hardly accept my evidences of cannibalism, but if they point that way he is ready to show that, though the Ainos are gentle and mild in manner now, it was not so formerly, and that they might have been cannibals, and he offers, in the absence of necessary testimony, that the Japanese annalists would have left unrecorded customs and practices, which would have thrown discredit on their race. This is a novel idea.

The question is simply, were the Ainos cannibals? not, were the Japanese cannibals. Mr. Siebold calls the shell heaps Aino

in their origin. Since the Japanese had fierce wars with the Ainos it would be past believing that they—bitter enemies as they were of the Ainos—would refrain from any feeling of delicacy in fastening every possible stigma, in reporting every possible crime about them.

The Ainos were looked upon as debased, as having an animal origin; what more probable than that every hideous feature of their life be recorded and perpetuated?

This important evidence being wanting, Mr. Siebold tries to make out that the Japanese were cannibals. Does he do this on the strength of their own historians or Chinese chroniclers? No, but on the testimony of Marco Polo! He who found in Japan temples roofed and paved with massive gold, who saw quantities of precious stones, who describes an invasion and storming of a city, the garrison put to death, all excepting eight, who by the efficacy of a charm introduced between the skin and the flesh of the right arm which rendered them proof against sharp swords, either to being killed or even wounded, and so they had to be beaten to death with wooden clubs!

In the face of the records we have preserved to us by the Japanese annalists, of the etiquette at the table, the dishes used at their feasts and offerings, and later still the development and institution of the refined and delicate ceremony of tea drinking, the *cha-no-yu*, not to speak of the persistence of their religious prejudice against the eating of flesh, is it possible that Mr. Siebold can really give credence to the following circumstantial account of Marco Polo. This extraordinary writer says, "that these people on capturing an enemy that was not ransomed, invited to their house all their relations and friends, and putting the prisoner to death, dress and eat the body in a convivial manner," etc., etc.

With these few criticisms, Mr. Siebold's work must be looked upon as a most excellent contribution to a knowledge of the archæology of Japan.—*E. S. Morse.*

Balfour's Comparative Embryology.[1]—Only within a year or two, owing to the rapid advances made in our knowledge of the embryology of the invertebrate animals, could this book have been prepared. It comprises a body of facts and, in the main, probably sound generalizations, which afford the student the only starting point for studies of this sort. The author has brought to his task much experience in the embryology both of vertebrates and invertebrates, and this knowledge, with wide reading and good critical powers, have rendered the book a reliable, standard authority. As such it is most useful and timely.

The first volume is confined to the many-celled invertebrate animals, beginning with the sponges and ending with the Echino-

[1] *A Treatise on Comparative Embryology.* By Francis M. Balfour, F.R.S. In two volumes, Vol. I. London, Macmillan & Co., 1880. 8vo, pp. 492, xxii. $4.50.

derms; the Protozoa not being considered. The author has evidently adopted Lankester's classification, as the Tunicata are not referred to in this volume, and will, undoubtedly, be taken up in the vertebrate volume.

The introduction treats of the development of the ovum and spermatozoön, the maturation and impregnation of the ovum, and its mode of segmentation. These subjects are treated in a clear way, with an abundance of illustration, and this portion will be found as useful as any part of the book, since the phenomena have been traced by but a few and are rather difficult to comprehend.

The introduction to systematic embryology refers to the mode of origin of the germinal layers, and the gastrula, both by invagination and by delamination, the figures very clearly showing these different modes of development of the germinal layers and primitive digestive cavity. We observe that Mr. Balfour uses the convenient terms morula and gastrula to express the two earlier stages in the life history of most animals, though he is unable to perceive a true gastrula condition in the Tracheata.

The remainder of the work is devoted to special accounts of the mode of development of such types of the different classes as have been studied. These include the Dicyemidæ and Orthonectidæ, Porifera, Cœlenterata, Platyelminthes, Rotifera, Mollusca, Polyzoa, Brachiopoda, Chætopoda, Discophora, Gephyrea, with references to the aberrant types of Chætognatha, etc., Nematelminthes, ending with the Tracheata, Crustacea, Pœcilopoda, Echinodermata and Enteropneusta, in the order here given. This order represents the author's views as to the classification, or what is but another name for it, the phylogeny of the invertebrates. We are gratified to see that the author assigns the sponges to a group by themselves, while the Mollusca have the same rank assigned to them as to the Polyzoa or Brachiopoda. We scarcely see why the Echinoderms are placed so far away from the Cœlenterates and worms.

At the end of nearly every chapter, after treating of the individual development, that of the organs is discussed, and finally, as in that on the insects (Tracheata), we are treated to a rehearsal of the general mode of formation of the layers and embryonic envelopes, with a full bibliography. As regards the latter it would be much more convenient to the student, especially the beginner, if the works had been cited in the order of publication, so as to induce one to study the history of the literature. After treating of the Tracheata and Crustacea, and Pœcilopoda, Pycnogonida, Pentastomida and Tardigrada, an excellent summary of Arthropodan development is given.

The theoretical portion relating to phylogeny is kept apart, and is discussed in a generally conservative and judicious way; the bearings of palæontology, though of primary importance as

checking too free interpretation of purely embryological processes, are not discussed. In the introduction the credit of the correlation of the development of the individual and the class to which it belongs, should have been given to Agassiz and to Milne-Edwards, however much it has been extended and modified by later evolutionists. We find little to criticise in the author's general views. The illustrations, where originally prepared for the work, are nearly faultless, with two or three exceptions.

THE ODONTORNITHES, OR BIRDS WITH TEETH.[1]—The present memoir presents the results obtained by Prof. Marsh from the study of the remains of this interesting group, procured by him during the last ten years. It is generally known that the specimens which represent the *Odontornithes* have only been found in America in the Niobrara Cretaceous, or No. 3 of Meek and Hayden, and within the geographical limits of the State of Kansas. Prof. Marsh's book sets forth principally the osteology of four species of the group, viz: *Hesperornis regalis*, *Apatornis celer*, *Ichthyornis dispar* and *Ichthyornis victor*, all discovered and named by himself. This work appears to have been well done, and it is worthily supplemented by thirty-four good lithographic plates. The conclusions of the author respecting the affinities of the genera of which he treats, are fully and clearly set forth. His discussion of the probable phylogenetic relations of *Hesperornis* are especially interesting. He shows that the modern affinities of this genus are with the Struthionoid types, while those of *Ichthyornis* and its allies are remotely to the *Longipennes*. He includes *Archæopteryx* in the same primary division. Thus constituted the *Odontornithes* are a group "homologous" with a part (perhaps all) of the remainder of the class Aves, and the two great divisions thus formed embrace corresponding or "heterologous" subgroups. In his discussions the author adopts the theory of the production of modification of structure by use, a doctrine first fully formulated in an essay in this journal.[2]

A supplement to the chapters above mentioned includes a synopsis of all the species of birds hitherto found in the Cretaceous formations of North America, twenty in number, all named by the author. We should like to have seen introduced here some clear descriptions of several of the genera named by Prof. Marsh, but whose characters we are yet unacquainted with. Some reference to the first discovery of birds with biconcave vertebræ in England by Seeley, in 1870,[3] would also have been in place. Mention of the extent and character of the services for which Mr. Oscar Harger is thanked in the introduction, would also have been proper.

[1] *The Odontornithes, or Birds with Teeth.* By O. C. MARSH. Memoirs of the Peabody Museum of Yale College, Vol. I, 1880. 4to, pp. 200.

[2] 1871, p. 603. Proceed. Amer. Philos. Soc., 1871, 253.

[3] *Annals Magaz. Nat. Hist.*, p. 129.

THOMAS' NOXIOUS INSECTS OF ILLINOIS[1]—This report contains chapters on the insects affecting the cabbage, with a brief account of the parasites of domestic animals, and closes with an essay on the classification of the Acrididæ, or that family of locusts of which the Rocky Mountain pest is the type. The portion on cabbage insects contains considerable new matter. It is to be hoped that the State will furnish more original illustrations and better paper and press-work for subsequent reports, as these publications are of great value to the people. There are less typographical errors in this than in the two previous reports.

TRANSACTIONS OF THE ENTOMOLOGICAL SOCIETY OF LONDON FOR 1879.—This volume is rather thinner than its precursors, and while scarcely as important as usual may give a fair idea of the conditions and doings of the chief entomological society of Great Britain; indeed it stands nearly alone, for what other associations of a like nature there may be, are local and inconsiderable. There are twenty-five memoirs filling only 346 pages, so that the papers are, in most cases, quite brief; of this number twenty are descriptive, most of them purely so, and a few are simply faunal lists, mostly of exotic insects, and prepared by the officers of the British Museum.

Those more general in their nature and of interest to our readers, we will notice more at length. Eleanor A. Ormerod contributes some brief observations of the effects of low temperatures on larvæ; it appears that during the unusual cold of last winter in England, the insects were frozen, but eventually thawed out and were not seriously affected; what is said is confirmatory of what has been previously observed. In Dr. Fritz Müller's notes on the cases of some South Brazilian Trichoptera, or caddis flies, he describes those of *Rhyacophylax*, "the most curious of all our Hydropsychidæ." The cases themselves are rather rude canals covered with irregularly interwoven vegetable fibers, but at its mouth end each case has a large funnel-shaped veranda covered with a very beautiful silken net. The larvæ live in the rapids of various rivulets, and the entrance of the veranda is invariably directed towards the upper part of the rivulet, so as to intercept any eatable things brought down by the water."

In his morphological notes bearing on the origin of insects, Mr. J. Wood-Mason, of Calcutta, discusses certain points in the morphology of insects. He labors to prove that the antennæ of Machilis are homologues of the "antennæ (III) proper" of Crustacea, on the ground that he finds a process on the peduncle or base of the antennæ, which he thinks may represent the second or smaller branch of the antennæ of the Crustacea; especially as he finds a movable appendage present in Lepisma, and a large coni-

[1] *Ninth Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois.* By CYRUS THOMAS, Ph.D., State Entomologist. Springfield, 1880. 8vo. pp. 142.

cal process in Blatta. He compares these structures with the second branch of the bifid antennæ of Pauropus. We may add that in certain coleopterous larvæ there are similar movable processes. These may be found to exist in other low or larval insects; but while interesting and suggestive, we scarcely see the need of going so far as to homologize them with the bi-flagellate antennæ of the Crustacea. These attempts are due to the hypothesis that the insects have been derived from the Crustacea, instead of what has seemed to us the better grounded view that the two classes have independently arisen from the worms, and also it is forcing nature into a straight jacket to attempt to institute too close homologies between the members of two classes.

Mr. Mason next shows that the mandibles of Machilis are articulated to the head just as in the chilognathous myriopods, though he adds that the joints are not movable. We have found what we suppose to be less distinct traces of an articulation in the mandible of Campodea. He concludes that the mandibles of the cockroaches are compound structures, "each made up of three (or four) such joints as are to be seen in Machilis."

Our author then asks, "Are the mandibles of insects and myriapods, like the jaws of Peripatus, modifications of walking legs?" He answers the query in the negative, and his reasons for his conclusion are apparently due to the influence of the hypothesis that insects are derived from Crustacea and not first hand from the worms. He judges that the mandibies of the higher Thysanura and the cockroaches as well as the myriopods "have resulted from the direct modification of such a biramous appendage as is seen in the earliest (nauplius) condition of many crustaceans." Embryology shows conclusively that the mandibles and in fact all the appendages of the head of both Crustacea and insects arise in the same manner and have the same form as the thoracic appendages. Would this not indicate that both arose from worms in which the rami and tentacles are obviously identical in form, and but slightly differentiated in function; and that the two classes followed distinct developmental paths, one with limbs adapted for swimming, as in the nauplius, with limbs all alike and no head differentiated from the rest of the body; while the terrestrial ancestor of the insects at once assumed what we have called the Leptus condition, having a head separate from the rest of the body, with biting appendages as distinguished from the walking limbs of the rest of the body? It seems to us that this is the broader, more tenable view. If we give ourselves up to too isolated, analytical views in animal morphology we shall be forever wandering, drawn hither and thither by false lights, when we should be guided by broad principles, of general application—but we do not wish to sit in judgment on the opinions of a most excellent observer.

Another point of interest studied by Mr. Mason is the nature

of "the abdominal appendages, which, in Machilis, are movably articulated to the hinder margin of the sterna of the eight antepenultimate somites, a pair to each somite." These as well as similar ones in Scolopendrella, he compares to the exopodite of Decapod Crustacea, notably Peneus, and thinks this an additional argument for the crustacean origin of insects. Now while Mr. Mason has pointed out some interesting points of resemblance between the Crustacea and insects, we do not think that these crustacean features have been derived from the Crustacea; but that they have independently arisen in the ancestral forms of each class. It will be interesting to follow up Mr. Mason's "suspicion that the limbs of myriopods are not strictly homologous with those of insects, but that they correspond with the rudimentary appendages of Machilis, and are consequently exopodites, the appendages of the legs in Scolopendrella representing the legs of insects, which would appear to be endopodites." This may or may not be the case, but we should not desire to fall into the error of drawing too close homologies between two sub-classes like the hexapodous and myriopodous Tracheata (insects).

Finally, our author, after considering the remarkable difference in the position of the genital openings exhibited by the different groups, and very generally by the opposite sexes of Arthropoda, believes this is "intelligible on the hypothesis that all the members of the sub-kingdom have descended from some worm-like creature, provided in every somite of its body with a pair of segmental organs or nephridia, and that different pairs of these organs have, in different descendants of this hypothetical ancestor, been connected in the genital aperture and ducts."

In a paper on the affinity of the genus Polyctenes, Mr. C. O. Waterhouse conclusively proves, by a winged form closely allied to the wingless Polyctenes, that this insect belongs near the Hippoboscidæ, or horse-ticks and bird-flies. In a brief paper on the natural affinities of the Lepidoptera hitherto referred to the genus Acronycta, M. A. G. Butler removes several of the species to the Arctiidæ, a subdivision of Bombycid moths. Our own observations on the structure of the head as well as the general form of the body, made several years ago, lead us to think that such a removal is quite unwarranted, and that the interesting analogies to the Bombycids are superficial, and not fundamental.

Recent Books and Pamphlets.—Description of four new species of Silurian Fossils. By S. A. Miller. (From Jour. Cin. Soc. Nat. Hist., July, 1880.) 8vo, pp. 5, Pl. 1, 1880. From the author.

The Three Climates of Geology. By C. B. Warring. (From Penn Monthly, June, 1880.) 8vo, pp. 36. From the author.

Contributions to Invertebrate Palæontology, Nos. 2–8. By Dr. C. A. White. (Ext. from the Twelfth Annual Report of U. S. Geolog. Surv., 1878.) 8vo, pp. 171, Pls. 42. From the author.

The Hessian Fly. By A. S. Packard. (Bull. No. 4, U. S. Ent. Com.) 8vo, pp. 43, Pls. 2, Map 1. From the author.

Etude sur les Grenouilles Rousses Ranæ Temporariæ et Descriptions d'Espèces Nouvelles ou Inconnues. Par G. A. Boulenger. (Ext. Bull. Soc. Zool. de France pour 1879.) 8vo, pp. 38. From the author.

The Plowshare. By Henry M. Parkhurst. Vol. XXXII, No. 3. 16mo, July, 1880. From the editor.

On the Zoölogical Position of Texas. By Edw. D. Cope. (From Bull. U. S. Nat. Museum.) 8vo, pp. 51, August 1st, 1880. From the author.

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GENERAL NOTES.

BOTANY.

Contrivances for Cross-fertilization in the Ranunculaceæ.—In Ranunculus the stamens near the honey pores are adnate-extrorse to scatter pollen upon insects as they take honey. The receptacle is elongated to elevate the ovaries and furnish a firm, conspicuous platform, so that insects will first alight upon them. An elongation of the styles simply would not accomplish the purpose.

In Aquilegia the pollen is very rarely if ever discharged till the anthers are beyond the stigmas. As the flowers are pendant this prevents its falling upon the stigmas even if they were prepared to receive it. The spurred petals are placed on all sides of the stamens so that in passing from spur to spur the stamens are almost sure to be brushed. After the stamens have all discharged, the styles then elongate and the feathery stigmas open and curve sidewise so as to bring themselves before the mouths of the petals and at about the same distance at which the anthers were in the staminate stage of the flower.

I have seen humming birds visit the columbines and they seem especially adapted to fertilize them.

In Delphinium one sepal is spurred and two petals are utilized to make the stiff rim for its mouth. Two other petals, or in some species projections from the two already mentioned, serve as a kind of apron to protect the stamens and pistils till each is fully mature. The stamens are first to become so; at which time, by an elongation and bending of the filaments, each anther is brought from under the petals and placed before the mouth of the spur. After discharging pollen, each is withdrawn by a contrary movement of the filament. In a similar way, after the stamens are through, the stigmas are brought into the same position.

In both Aquilegia and Delphinium the outer stamens mature first, the inner meanwhile forming a sheath for covering the pistils. The degrees of complexity in these flowers and the intermediate position of Aquilegia need only to be mentioned to be readily

seen. Delphinium may be considered the highest and latest developed type of the three, and *D. consolida* would seem to be of later origin than *D. tricome* and others. Aconitum may be a stage between Delphinium and Aquilegia.

The history of these different structures, the spur, the automatic filaments, etc., offers a very attractive field of investigation. The Ranunculaceæ, on account of their wide distribution, great numbers and variety of forms, seem especially favorable for studying this branch of vital dynamics.—*J. E. Todd, Tabor College, Iowa.*

Botanical Notes.—The process of fertilization of the tulip by Halictus bees is described in the *American Entomologist* for June, by W. H. Patton, who questions whether the nectar is poisonous, as stated in Miss Stavely's "British Insects."——The fertilization of *Cobæa penduliflora* of South America is effected, says A. Ernst, in *Nature*, by large Sphinx moths, and no flower gave a fruit without having its stigmata pollenized by crossing, self-fertilization being therefore excluded; he also confirms Bonnier's statement that the nectar is of no direct advantage to the plant. ——In this connection may be mentioned the excellent treatise of Mr. William Trelease on nectar, its nature, occurrence and uses, which appears in the report on cotton insects issued by the Agricultural Department, and which we notice in another place. ——Dr. H. Müller continues in *Kosmos* (iv, Heft 4, July, 1880) his series of papers on the relation of Alpine flowers to the theory of the production of flowers.——Dr. Eberth describes a Bacillus which he claims caused the death of a badger, the bacilli appearing to actively excite inflammation, the animal dying after a few days' illness, showing no other symptoms than decrease of appetite and weakness. The disease germs appeared in the liver, sections of the capillaries being crowded with them. ——Mr. W. T. T. Dyer contributes to Trimen's *Journal of Botany* an article on Lattakia tobacco, which owes its flavor to being smoked with the wood of an oak, *Quercus ruber* var.

ZOÖLOGY.[1]

A new Harvesting Ant.—We have a true harvesting ant, it appears, at our very doors. In Vineland they are on every street, in every yard. At Island Heights, Ocean Grove, also, and Asbury Park, they are very numerous. A very large colony may be seen on the lawn opposite the Arlington House, at the former place. I have not looked for them farther north, but have no doubt they will be found generally in our latitude.

It is a small ant, the worker being about a line long. It is of a red-

[1] The departments of Ornithology and Mammalogy are conducted by Dr. Elliott Coues, U. S. A.

dish-brown color. The head is rather large. The head of the soldier ant of this family is a marvel for size, being many times larger than the abdomen. It is not above working when necessary, but is not commonly seen on the surface. It appears to rule its community, and certainly furnishes the brains of the family, in bulk, at least. In battle it is a very Ajax. It is a ferocious, murderous warrior. A war between them is a terrible thing in a small way. They cut each other in two and yet continue to fight. I have on my table, now, a pair whose abdomens have been cut off just back of the posterior pair of legs, so that they run about without any apparent embarrassment. A few moments since I placed them near each other. They gave every sign of undiminished rage and courage and flew at each other as if in the best condition. And, as I write, one of these bodiless heads is actually walking off with the other. These unconquerable contestants were taken from formicaries about fifty feet apart. Under a good objective these heads exhibit the characteristic striæ of *Pogonomyrmex crudelis* Forel, as I am informed by Mrs. Treat, an excellent authority.

The males and females are several times larger than the workers. I should think the female would outweigh forty of the little fellows. Though bothered with wings, the females are at this moment diligently excavating, in a small artificial formicary in which, as yet, I have placed no soldiers, but workers and females only. I have made many interesting notes concerning these strangers, which I may hereafter give to the public. I have sent specimens to Dr. Forel, who informs me that they belong to a variety of *Pheidole pennsylvanica.*

The rejected husks of seed carried out and piled up by their doorways first called my attention to them and revealed to me their character. It would seem that they do their house cleaning in the latter part of June, to be ready for harvesting the new crop of grass and other seed now ripening. Here and there, however, a careful eye may detect signs of some later work in husks just brought from below. Grass, clover, sorrel or other seed put near them will be seized and carried below with evident eagerness.

They have a violent antipathy to the little yellow ant—the pest of the pantry—a fact which may be used in recognizing them. Place a piece of cake full of the yellow ones near any formicary supposed to belong to the harvester and, if the supposition is correct, you will have the pleasure of seeing the big-headed soldiers rushing out with gaping mandibles eager to crush the tiny foe, and prevent the threatened invasion.—*Rev. G. K. Morris, Vineland, N. J.*

BUDDING IN FREE MEDUSÆ.—In a review of Packard's Zoölogy by J. W. F. in the August number of the NATURALIST, the following passage occurs: "On page 60 the author says, 'Budding

occurs in the medusa of *Sarsia prolifera*, the only example known of budding in free medusæ.' Alex. Agassiz has shown that budding occurs in the free medusa of *Lizzia grata*, also in *Dysmorphosa fulgurans* and in *Hybocodon prolifer*. These medusæ are all found in New England waters. Many similar cases have been described in Mediterranean genera."

By an odd chance I had under the microscope, at the time I read this article, a medusa, a Willia, which must be added to this list, as it produces medusæ by budding from the base of the manubrium. During the latter part of July I took with the dipping net, in Beaufort Inlet, N. C., a great number of specimens of *Willia ornata* (McCr.) at various stages of growth; they agreed perfectly with Mr. Alex. Agassiz's description and figures, and show that the latter author was correct in referring two specimens to the same species as the single specimen found by McCrady at Charleston. With them was a single specimen of another form, which at first appeared to belong to a second species of Willia. Although it was larger than those of the common form in which the reproductive organs were fully developed, these were entirely wanting; there was a slight difference in the outline of the bell; the tentacles were only eight in number, short and thick, and usually carried coiled up under the edge of the bell. The tubes with the clusters of lasso cells, contained only a single cluster each, instead of two or three clusters, as in the ordinary form.

On the inner surface of the bell, where the radiating chymiferous tubes joined the manubrium, and therefore nearly in the position which is usually occupied by the four reproductive organs, four long branchial stolons hung down into the cavity of the bell, and the tip of each branch terminated in a medusa bud, with four rudimentary tentacles.

The general resemblance of this form to *W. ornata*, the occurrence of the two together, and the absence of reproductive organs, seems to indicate that we have, not a new species, but an asexual form of *W. ornata*, which gives rise to the sexual medusæ by budding, so that we have an alternation of generations of free medusæ.

The specimen soon died in confinement, and as stormy weather set in that night I got no more of them, hence the question whether the two forms belong to the same species must therefore be left in doubt for the present.—*W. K. Brooks, Beaufort, N. C.*

English Sparrows refusing to eat Worms.—One can hardly blame either bird or beast for not liking to eat caterpillars and canker-worms, but when it is claimed that that is what the English sparrow is for, it is well to keep the facts of the case before the people, as a great many persons are doing. I observed a "sin of omission" on their part here in Washington, which I do not remember to have seen in print. After every rain the

common earth-worm comes out of the ground in great numbers, and upon the walks through the Smithsonian grounds, for example, where sparrows are abundant, they remain until they are dried to a crisp in the sun or crushed by the feet of pedestrians; and the sparrows are meantime rumaging the horse droppings in the street for, to them, more acceptable food. If they are really an insectivorous bird they surely ought not to refuse earth-worms, which are favorite food with such birds.—*C. A. White.*

HOW INSECTS RESIST COLD.—The cocoon surrounding an insect affords little protection, relatively, to temperature. Where a pupa resists congelation, it does so by virtue of a continuous and considerable liberation of heat. Whence is this production? According to Dr. Jousset de Bellesme (*Les Mondes*), it is very probably due to the organic transformations taking place in the pupa. Without going so far as to say (with some naturalists), that all the organs are destroyed to be built upon another plan, it is certain (speaking only of the muscular system) that there is a disappearance of certain muscles that have served for the larvæ, and formation of new ones, to be used by the perfect insect. Such work could not be done without a reciprocal liberation and consumption of heat, which would compensate one another if the reconstructed muscles were the equivalent of those destroyed. But the muscular system of the larva is much more considerable than that of the perfect insect, hence all the heat rendered disposable by destruction of the old muscles is not utilized in construction of the new ones. Further, uric acid and its derivatives are found abundant in the insect which has been metamorphosed, and this is another proof of the existence of active combustions during the pupal period. It is then apparently, to these organized chemical phenomena that we must attribute the facility with which insects, in the course of transformation, bear very prolonged depressions of temperature.

"MIMICRY" IN SNAKES.—In the NATURALIST for September, the question is asked, "Does the fox-snake 'mimic' the rattlesnake?" This recalls an experience of mine that occurred several years ago, when collecting plants in the vicinity of Panola, Miss. A snake of an unknown kind running along in the low grass was pursued to some rails that lay in a loose pile on the ground where it had fled for safety. By means of a stick of sufficient length, after finding it, I held it fast to the side of a rail, when I was surprised and startled by a buzzing sound from its tail. The first thought was that I had a rattlesnake, but a glance at the tail and the color of the skin at once disproved this. Feeling safe from being bitten, the hold was kept, and the phenomenon observed. The tail, vertically flattened either naturally or for the occasion, was thrown into rapid vibrations from side to side. The snake was very angry at being held, and I thought this its

mode of showing its spite. The sound seemed hardly as acute as that made by the rattlesnake, but may have been somewhat modified on account of the beating of the tail against a rail, as it did from its position. It was, however, a close enough imitation to cause one, on hearing it, to get out of the way of harm. My description of the way of producing the sound would be in almost exactly the same terms as those used by Mr. King, though, if I remember rightly, it was more continuous, still it was not without interruptions. On loosing my hold to get a better chance to kill the snake, being uninjured it glided rapidly away, and escaped among the grass and bushes, and, as I was not in search of that kind of specimens, no further pursuit was made. I did not know the species, but from its slender form, dark color, and rapid running, should think it a Coluber, or one nearly allied to that genus. Its length was about five feet.—*E. J. Hill, Englewood, Ill.*

NOTES ON THE MAMMALS OF SOUTHERN UTAH.—We have grizzly bears in small numbers in the mountains, although I have never been so fortunate (?) as to meet with one, but I have known of two being killed in the neighborhood of Ranch. I spent much of my time on the Pauns-a-gunt Plateau this summer, from June to November, and during the whole time I did not see any sign that indicated that bear of any kind were there or had been for a long time. The Indians say that they never find them there but that they are abundant on the Mar-ka-gunt Plateau. Black and cinnamon bears are reported, but they are very rare ; I have never seen even a pelt of one that was killed in this locality. Of deer we have but one species, as far as I can learn, that is the mule deer. They frequent the high plateaus in the summer time when they kid in June and July ; in October they come down upon the benches about the water courses where there are oaks, and remain until after the rainy season, when they go back upon the mountains, if the snows are not too deep ; when this is the case they range on the sides of the mountains and at the foot of them on the broken hills. They are not as wary nor as fleet of foot as the fallow deer, as they will stand with head down evidently to hide their long ears in a bunch of brush, and allow the hunter to pass within a few steps of them without their running or, in fact, stirring. They seem to understand that their safety depends upon, what many of this world's folks have not learned to do, *i.e.*, keeping still. The Indians that hunt them at fawning time, tell me that they seldom find a doe with two young. They change their color in the fall of the year from a dirty clay color to a gray or ashen color with yellow legs ; they have the power of erecting their hair when excited, and then are almost black. They are hard fighters ; I have one, a pet doe, five months old, that whips any dog that comes about the place, using her fore legs as clubs to strike with, and when this is not efficacious jumping with all

four feet upon her enemy; the last stroke always does the work. I got sight of two animals last August on Pauns-a-gunt Plateau; they were blue in color, with horns like a goat, five others were seen on the same plateau; I do not know what they are nor do I know anything about their habits. On the same plateau are panthers and wild cats, with porcupines and badgers. Everywhere can be found that hen-roost robber the coyote; it will eat fowls, rabbits, crows, crickets, grasshoppers and almost anything else of animal kind, including yellow jackets. Nests of small animals, white bellied or ground mice, gophers, kangaroo rats, mountain rats with their large pop eyes and flat tail, are abundant.—*A. L. Siler, Ranch P. O., Utah.*

ICHTHYDIUM OCELLATUM.—I have found this singular Infusorian, first described by E. Metschnikoff, from German waters, in great abundance in a land-locked salt pool near Mobjack bay, New Point Comfort, Va. It was associated with vast numbers of another member of the same family, viz: *Coleps hirtus* Ehbg. There were also great numbers of a small Amœba present, together with a species of Difflugia, which appears to be *Arcella vulgaris*, with which a large holotrichous Infusorian, which I did not determine, was often literally stuffed. The supposed eyes of *Ichthydium ocellatum* did not appear as distinct to me as they are figured by Metschnikoff. The chitinous annulate œsophagus and the singular backward prolongation of it, which it is hard to believe is a true intestine with a proper wall, was clearly seen. The zoölogical position of these symmetric Infusoria, as they were called by Dujardin (*Gastrotricha* Metsch. and Class, *Nematorhyncha* of Huxley), still apparently remains to be settled.—*J. A. Ryder.*

ON THE COURSE OF THE INTESTINE IN THE OYSTER (OSTREA VIRGINIANA).—In investigating the anatomy of the American oyster, under the auspices of the Maryland Fish Commission, at St. Jeromes creek, Md., I find an arrangement of the intestine so remarkable that I will briefly describe it. The mouth is a wide opening between the upper median angles of the palpi; so wide indeed, that the animal can scarcely be said to have an œsophagus; immediately follows the stomach, which is seen to have very pronounced folds internally, with a generally transverse direction, but two of these which lie in a somewhat ventral position, are a pair of inward projecting lobes which are themselves lobulated. The intestine then follows an oblique course, downwards and backwards, when it makes a sharp bend returning beneath the floor of the pericardial space, passing obliquely upwards and forwards, somewhat to the right and dorsad of the stomach, when it crosses exactly over the mouth or very short gullet, passing downwards to the left side of the animal, alongside and a little to the lower side of the stomach, when it again turns upwards and passes

over the pericardial space to end in the rectum just over the middle of the adductor muscle. The liver, as is well known, dips into the folds of the walls of the stomach, but does not seem to follow the course of the intestine proper, which is provided internally with a curious pair of longitudinal and parallel folds, which project into the intestinal cavity and extend from the pyloric end to very near the anus. The presence of these folds, gives to the fœcal matters their singular appearance, which is not in the form of a cylinder as they leave the vent, but in the form of a tube with a part of one side removed. Tracing the course of the intestines by sections is not the proper way; they can be very easily dissected out for their entire length by means of the scissors and forceps.

The general likeness of this arrangement of the intestines to that of other Lamellibranchiates is apparent, but I was not prepared to find it return and cross over the mouth so very far forwards. Prof. Brooks[1] apparently believes the intestinal coils to lie behind the stomach and liver, which is not the case according to the foregoing observations, nor is the use of the words "coils" and "convoluted intestine" admissible, since there is but one complete turn of the canal upon itself.—*J. A. Ryder.*

PHOSPHORESCENCE OF VERY YOUNG FISHES.—Whilst investigating the development of *Cybium maculatum* and *Parephippus faber*, or the bay mackerel and porgy, under the auspices of the United States Fish Commission, in Mobjack bay, Virginia, I found that the latter species, when three days old, was very decidedly phosphorescent at night when sudden impulses were imparted to the sea water in which they were swimming about, acting in this regard in relation to such sudden vibratory impulses the same as numerous species of marine animals, such as some worms, Medusæ, Polyps, Infusoria and many larval forms of Crustacea and other marine types which swim at the surface of the water at night. The presence of an extraordinary development of amœbaform cells over certain parts of the bodies of these little fishes, may be the cause of these phenomena. So striking is the resemblance of these migratory superficial amœba-like cells to some of the *Protoplasta*, that were it not that they lack a contractile vesicle they might readily be regarded as their homomorphs.

These cells, moreover, change their forms from time to time very considerably, but tend to aggregate in anastomosing clusters, a sort of syncytium over the oil-globule in the umbilical vesicle; over the ectoderm of the vesicle itself and on certain portions of the body and tail. They are very different from pigment corpuscles, which are also present.

Besides these cells a peculiar homogenously distributed reddish

[1] Development of the American Oyster (Biological Studies from the Laboratory of Johns Hopkins University, No. IV), pp. 9–10.

tinge is acquired by the membranes of the umbilical vesicles of the porgy on the third day, which is not due to the presence of blood globules.

To whichever of these structural causes, the phenomenon of organic phosphorescence is attributable in this special case, there seems to me to be little doubt that the prime element in the production of phosphorescence in the animal world in general, is some kind of sudden molecular disturbance or impulse, disturbing the equilibrium of the molecules of the living protoplasm involved, so as to produce a kind of motion which makes itself apparent as momentary emissions of light. I have no doubt that the phenomenon in Lampyris or the fire-fly, is connected with expiration and inspiration, and possibly in the Medusæ with the rhythmical contraction of the umbrella. The application of experimental methods to verify the above suggestions would be very easy.—*J. A. Ryder.*

ZOOLOGICAL NOTES.—Mr. M. M. Hartog shows that the larvæ or zoëæ of cancer have, like the adult entomostraca, an anal respiration, the terminal part of the rectum being slightly dilated, and with a rhythmic contraction and expansion associated with the opening and closing of the vent.——Hybrids between males of Reeves's pheasant and hens of the common pheasant were exhibited at a recent meeting of the Zoölogical Society of London.——A honey ant with an immensely distended abdomen, like Myrmecocystus, has been discovered in Australia.——Reinfleisch claims to have demonstrated the origin of the red corpuscles of mammals; *i. e.*, the nucleus of the red-colored cell escapes and atrophies, while the body of the cell contracts and becomes the red corpuscle——The influence of light on animals has been studied, according to the Journal of the Royal Microscopical Society, by Moleschott and Fubini. It increases the excretion of carbonic acid and the ingestion of oxygen; but this influence is not only effected through the eyes, but by the skin, for it is seen in eyeless animals.——Weismann has found that several ostracode Crustacea, especially Cypris, reproduce parthenogenetically.——At the meeting of the Linnæan Society of London, held June 17. Sir John Lubbock presented additional observations on the habits of ants, especially concerning their powers of communicating their ideas to each other; he confirms the prevalent notion that ants possess "something approaching language."

ANTHROPOLOGY.[1]

MAYA CHRONOLOGY.—The Proceedings of the American Antiquarian Society, No. 74, contains a paper by Mr. Philipp J. J. Valentini, on the Katunes of Maya history. The Katunes were a series of notable events that transpired from the time of the

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

departure of the Mayas from their original home until their destruction. Don Juan Pio Perez, a learned Yucatecan, had found an old Maya manuscript containing this account, but failed to discover the author's name. From this precious document Mr. Valentini attempts to reconstruct the Maya chronology in the same manner that he deciphered the Mexican calendar stone. The results at which he arrives are as follows:

1. That the conquerors and settlers of the Yucatecan peninsula, as well as those of the Anahuac lakes, were joint participants in a correction of their national calendar about the year 290 B.C.

2. That about the year 137 A.D, when a total eclipse of the sun took place, the ancestors of both nations set out from their common fatherland, Tula, or Tulapan.

3. That about the year 231 A.D., both nations made their appearance on the coast of Central America, and succeeded in conquering a large portion of the peninsula.

GERMAN ANTHROPOLOGY.—The second number of *Correspondenz-Blatt* der deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte is taken up with a preliminary statement concerning an anthropological and prehistoric exhibition for Germany, which will take place in connection with their Anthropological Society in Berlin, in August of this year. In No. 3 we have an exemplification of what our German cousins accomplish by concentrating one's energies upon a single subject. Dr. H. Fischer, of Freiburg, who is the greatest living authority upon jade, jadeite, nephrite, chroromelanite and kindred material, gives us a detailed account of every specimen of implements made from these materials, and known to exist in public and private museums of Germany, Switzerland and Austria.

Venerable Archdeacon Kirby delivered a lecture before the Philological Society of London, Friday, April 30th, on the Cree language, and the use of the syllabic characters in teaching it to the natives.

Mr. J. B. Good has published at Victoria, British Columbia, a vocabulary and outlines of grammar of the *Nitlakapamuk*, or *Thompson tongue*, the language spoken by the Indians between Yale, Lilloet, Cache creek and Nicola lake, to which is added a phonetic Chinook dictionary, adapted for use in the province of British Columbia.

REPORT OF THE PEABODY MUSEUM.—It must be a source of unalloyed pleasure to our older archæologists to look back over the steady progress which a study weighed down at first with wild speculations has made toward becoming an exact science. Among the monuments erected to signalize this improvement and incite to increased activity, the Peabody Museum stands pre-eminent. The twelfth and thirteenth annual reports, constituting Nos. 3 and 4 of Vol. II, are quite up to the mark in the value of their origi-

nal papers: The report of Mr. Putnam, the curator, sums up the labors of Dr. Abbott, Mr. Schumacher, Mr. Gilman, Dr. Earl Flint, Dr. Edward Palmer, Mr. Curtis, Dr. Patrick, and of the immediate force of the institution. The list of contributions is followed by a series of papers, of which a brief sketch is appended.

Mr. Lucien Carr, who has thoroughly qualified himself for the task by studies abroad, gives measurements of 150 crania from California, in which the following characteristics are included: capacity, length, breadth height, index of breadth, index of height, width of frontal, length of face, length of nose, breadth of nose, basi-nasal length, basi-alveolar length, ptereon, nasal index, gnathic index, height of orbit, width of orbit, orbital index, zygomatic diameter.

Dr. C. C. Abbot continues his investigations upon the flint chips of New Jersey. Two kinds of workshops have been discovered, one near the natural sources of supply indicates that the Indians came indiscriminately, each to make points for himself; the other, that a few skilled workmen plied their handicraft. The other important discovery of Dr. Abbott is the existence of argillite points belonging to an earlier time than the same implements of flint-like mineral, and forming a connecting link between these latter and those found in the drift gravels of the river valley.

Mr. Paul Schumacher gives us the methods of making pottery and basket ware among the Kahweyahs, on the coast of California. The important points to notice are, the use of an oval dish for the potter's wheel, and the use of the bone needle in stitching basket ware.

The article of Mr. Elmer R. Reynolds on soapstone quarries has been noticed in another connection.

The Hon. Lewis H. Morgan having visited the Pueblos in 1878, studied closely the ruins of a stone structure on the Animas river in New Mexico, and presents his results in an illustrated paper. Mr. Morgan is quick to discern the connection of the environment with the kind and degree of progress which a people have made. To the presence of the peculiar adobe soil, the cleavable sandstone of the bluffs, and. to the climate, the ancient cliff and pueblo people are indebted for the material cause of their advancement. Mr. Morgan strenuously denies the knowledge of caustic lime mortar anywhere in aboriginal America; but admits that gypsum may have been used as a bond. While expressing his astonishment at the amount of skill exercised by a people so poorly furnished, the author does not fail to recognize the long and tedious miles intervening between their gradus and ours. At the close of the paper occurs this significant sentence, "That the original ancestors of the principal historic tribes of Mexico once inhabited the San Juan country is extremely probable, that the ancestors of the principal tribes of Yucatan and Central America owe their remote origin to the same region is equally probable.

And that the Mound Builders came originally from the same country is, with our present knowledge, at least a reasonable conclusion."

We may, without the least fear of exciting envy, give the first place of merit to the paper of Mr.. Ad. F. Bandelier, on the "Social organization and government of the ancient Mexicans," occupying 142 pages of the report, and not falling below the author's communications on "The Art of War" and "The Tenure of Land" either in the importance of the subject or in the manner of treatment. All students of ancient Mexican sociology have felt the insecurity of Spanish chroniclers for two reasons. The most courtly and ceremonious people in the world could scarcely refrain from the use of such terms as "knight," "king," etc., when speaking of the Mexican rulers; and, secondly, every inducement existed to magnify the glory of their own deeds by exaggerating the numbers, valor, and culture of the Mexicans. This practice of embellishing, unfortunately has been perpetuated among modern writers of great genius. Mr. Bandelier, acknowledging what we have said above, and being profoundly impressed with the teachings of Mr. Morgan, has set himself the task of reconstructing the history of the ancient Mexican upon the systems of gentile organization contained in Morgan's "Ancient Society." The complicated nature of such a work necessarily determines the style of the communication; therefore, the great preponderance of notes over the text is partly justified. Long familiarity with ancient authorities and the coöperation of such distinguished Mexican scholars as Sr. Orozco y Berra and Sr. D. J. G. Icazbalceta, have specially fitted Mr. Bandelier for this difficult task. The special aim in the present member of the series is best told in the author's own words:

"There was, in aboriginal Mexico, neither state, nor nation, nor political society of any kind. We have found a population separated into tribes representing dialectical variations of speech, each tribe autonomous in matters of government, and occasionally forming confederacies for purposes of self-defence and conquest. Out of that confederacy, brought so prominently forward by the events of the Spanish conquest, we have selected on account of its military preëminence, one tribe—the ancient Mexicans—and we have shown that it was an organic body composed of twenty autonomous kins for purposes of mutual protection and subsistence. A social organization resting upon such a foundation must, of necessity, have been a democratic body. Indeed, we have found that each kin was governed by strictly elective officers, subject to removal at the pleasure of their constituents; that the twenty kins, for their mutual benefit had delegated their powers to transact business with outsiders to a council of the tribe, in which every kin was represented by one member, and consequently had the same voice and vote as any one of the others.

The execution of the decrees of this council was left to elective officers, whose power was limited to military command, and whom the tribe might depose at pleasure. With the exception of some inferior positions, these officers had not the power of appointing others to office, not even their assistants of high rank. The dignity of chief, so commonly transformed into hereditary nobility, has been found to have been merely a reward of merit, and carried with it no other prerogative than personal considerations and occasional indulgence in finery. Taking all our investitions we conclude *that the social organization and mode of government of the ancient Mexicans was a military democracy originally based upon communism in living.*"

THE AMERICAN ANTIQUARIAN.—The third number of Vol. II. contains the following papers, together with a large amount of interesting correspondence and editorial notes: The Mound Builders, by Stephen D. Peet; Brady's Leap, and other facts of Indian History, by J. P. Woodruff; Exploration of a Rock-Shelter in Summit Co., Ohio, by M. C. Read; Was LaSalle the Discoverer of the Mississippi river; Letter from Pierre Margry; The numeral adjectives in the Klamath Language of Southern Oregon, by Albert S. Gatschet; The Sign-Language of the Indians of the Upper Missouri, in 1832, by Colonel Garrick Mallery; Wampum Belts of the Six Nations, by Rev. W. M. Beauchamp. The first article is reproduced from the Proceedings of the "Congress of Americanists." Mr. Read's paper is a contribution to a little-worked portion of our anthropic area, but one that promises rich results. Pierre Margry holds that LaSalle discovered the Mississippi river, by way of the lakes, by Chicago, and the Illinois river, as far south as the 36th parallel, before 1676 (the date of Marquette's discovery). Mr. Gatschet's paper is an original communication of great merit, in which we find the numeral system of the Klamath Indians both laid down and explained. Col. Mallery gives us a segment of a great work which he is preparing under the auspices of Major Powell's Bureau of Ethnology, upon sign-language in general. Mr. Beauchamp is authority on wampum belts; and we have seen somewhere a set of drawings by this author giving the various designs represented on these belts.

ARCHÆOLOGY IN WISCONSIN.—Volume VIII of the Wisconsin Historical Collections, for the years 1877, 1878 and 1879, is a very important contribution to archæology. Before praising it too highly, we beg leave to caution the editors to read the proof of the next volume a little more closely, and to exclude the repetition of more than "thrice told tales," as on pages 148 and 149. The ancient copper-mines of Lake Superior are described by Mr. Jacob Houghton. On the south shore of Lake Superior the works of the ancient miners extend over a district of country comprising what is known as the Trap range, having a length of

150 miles through Keweenaw, Houghton, and Ontonagon counties, with a width varying from four to seven miles. They also wrought the copper deposits of the Trap range of Isle Royal, covering an area of about forty miles in length, by an average of five miles in width. The article by the Rev. Edmund F. Slafter, on prehistoric copper implements, treats the subject from an historical point of view. We drew attention to this paper on its first appearance in the *New England Historical and Genealogical Register*, for January, 1879. We are next treated to a *symposium* on copper-working—were the ancient copper-workers acquainted with the art of smelting copper? Mr. Draper opens the discussion, inclining slightly to the affirmative, and is followed by Mr. Fred. S. Perkins on the same side. The opposite view is advocated by Col. Charles Whittlesey and Doctor P. R. Hoy. It has occurred to us, as greenhorns, to ask some of our friends to try the effect of sound as a test. Make a mold of one of the implements supposed to have been cast. Take a cast copy, suspend it alongside of the original, by a wire, and strike them alternately with a rod of steel. A priori, if the original is cold hammered, it will be full of flakes and scales, and should give forth a duller sound than the cast copy. We are not strenuous advocates, however, of the "high priori" method. Indian pictography is now receiving a great deal of attention, and the Rev. Edward Brown has something to say about the Pictured Cave of La Crosse valley, near West Salem, Wis. On pages 188–194, Mr. Benjamin Sulté, of Ottowa, Canada, gives us a résumé of the labors of Jean Nicolet, in which the author affirms that "Nicolet must have traveled to the Mississippi, in the year 1634–5, from July to July, because that period is the only one during which we cannot find him on the shore of the St. Lawrence." The papers on the Rev. Eleazer Williams, by Gen. A. G. Ellis and Mr. Lyman C. Draper, pp. 322–352, are certainly interesting reading upon a very great conundrum. In this connection we may say that the Rev. J. P. McLean, of Hamilton, Ohio, will commence in the July number of the *Universalist Quarterly*, a series of three articles upon the study of American archæology. Mr. McLean is one of our most diligent workers in the West, and will, doubtless, present the subject in its latest phases.

CLIFF-DWELLINGS IN SOUTHERN UTAH.—Mr. A. L. Siler has discovered at Malley's Nipple Ranch, near Pahreah, Kane county, Utah, remains of cliff-structures, which he describes as follows: The remains seem to have been the foundations of small huts built on ledges of red sandstone under overhanging cliffs. The walls were about six inches thick, made of thin, flat sandstone brought up from the valley below, and laid in adobe. The structures are divided into rooms about four feet square, leaving all the space between the building and the back of the cliff, usually about ten

feet, entirely free. Upon digging into one of the rooms, Mr. Siler found parched corn and rope in a good state of preservation.

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REVIEWS AND NOTES.—Notice of Ober's "Camps in the Carribees," especially good, concerning the Caribs. *Athenæum*, May 15.——Announcement of the *Folk Lore Journal*, Vol. 1 (Capetown, Darter Brothers & Walton; London, Nutt).—— *The Academy*, May 1. Review of Dr. Lauder Lindsay's "Mind in the Lower Animals in Health and Disease." *The Academy*, May 1. "Early Man in Britain, and his place in the Tertiary period," by W. Boyd Dawkins. Reviewed by F. W. Rudler in *The Academy*, May 15.——The pamphlets of J. H. Rivett-Carnac, entitled respectively "Archæological Notes on ancient Sculpturing on Rocks in Kumoan, India" (Calcutta, Rouse); and "Prehistoric Remains in Central India," by the same publishers, are noticed in *The Academy*, May 15, p. 374. (The first named publication is especially interesting in connection with the subject of cup-cuttings.) ——Review of "Les Polynésiens: leur Origine, leur Migrations, leur Langage," by Dr. A. Lesson. 1. (Paris, Leroux.) *The Academy*, May 29, p. 399.——Prehistoric Antiquities of the Austrian Empire: Report of the Committee, &c., Imperial Academy of Vienna, Dec. 18, 1879. Notice in *Nature*, March 11, p. 457.

GEOLOGY AND PALÆONTOLOGY.

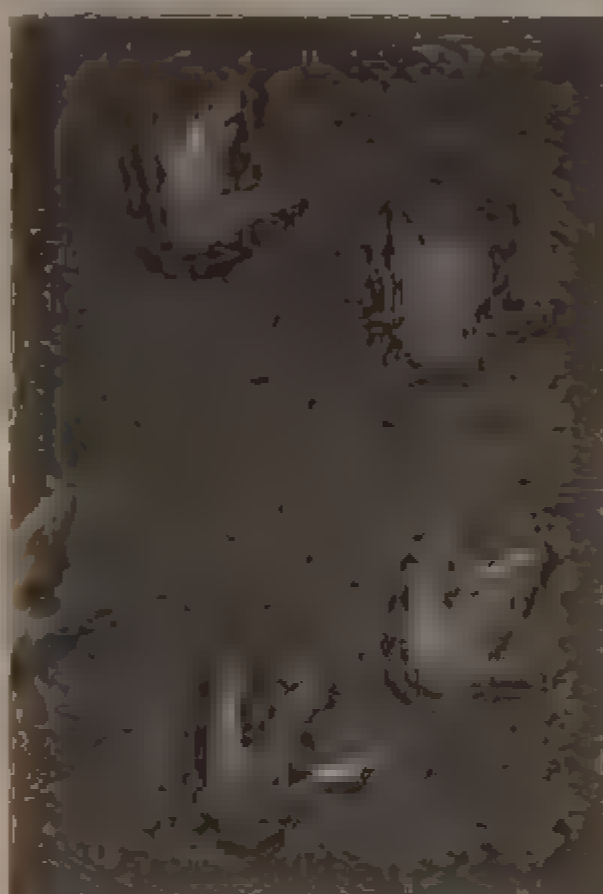
ON THE OCCURRENCE OF FOOTPRINTS OF DINORNIS AT POVERTY BAY, NEW ZEALAND.—When in Auckland, New Zealand, in 1875, my attention was drawn to some specimens of "Moa" footprints then in the museum of the Auckland Institute. After examining them carefully, I determined to procure some of these rare specimens for myself; with this intention I made a visit to the locality, which is on the right bank of the Taruheru river, near Gisborne, Poverty bay. Here I found what I so much desired to see in place, where hundreds and perhaps thousands of years ago, these great birds, sauntering in search of food, left their footprints indelibly impressed on the sand.

The portion of rocks in which the tracks are made (though many of them were nearly effaced by the action of the waves) was about fifteen to twenty feet in length, and from six to eight feet in width. Many of the impressions were close together, and with few exceptions were of nearly the same size. The tracks pointed in various directions, but some of them followed each other at regular intervals like successive tracks of the same bird, the strides were about nineteen to twenty inches from heel to heel. I noticed, however, some smaller tracks with strides of twelve and a-half to thirteen and a-half inches, which seem to accompany the larger tracks, as if they were made by a young bird, but these were too much effaced to be procured. At still another place I noticed some small tracks, such as might be made by a bird no bigger than a pigeon.

The tracks are in a soft sandstone which is being rapidly worn away by the action of the water and the weather, and the impressions are gradually disappearing. The sandstone is a mud deposit. We may imagine then, that these birds walked over the still wet sand, left by the receding of the river, a short time after it had subsided, leaving their tracks, and that afterwards the wind arose and drifted a coarser sand over them, as well as over the whole surface of the mud, to a depth of about half an inch.

The spot where the tracks are exposed to view is about at high water mark, and therefore much washed by the waves and so much effaced as to be scarcely worth removing. But by following up the surface of the sandstone stratum in which they occur, and judging by the direction they led, I split off numerous slabs of the overlying strata, in hopes of finding some better specimens, finally I traced them under a shallow bank, which was, perhaps, eight feet high, and was the lower part of a large plain; the upper portion is perhaps twenty-five to thirty feet high in some places, but whether these impressions ran under this to any great distance, it would be most impossible to tell unless a shaft was sunk on this plain. Running through the plain there are two rivers, viz: the Kopututea, which is formed by the confluence of the Waipaoa and the Arai, and occupies a middle position, rather towards the south-west of the plain; and the Taruheru, which falls into the sea at Poverty bay, at the north-eastern corner of the bay. At this point it was composed of sandy alluvium, containing shelly layers of recent species; below this occur successive strata of imperfectly solidified sandstone from four to six inches thick, and separated from each other by a thin layer of coarser sand and small pebbles, from a quarter to half an inch thick, and it is owing to this layer of comparatively loose sand that the impressions are so well preserved. At this point I dug out a slab two feet by three feet, of this soft sandstone, which is probably of Post-drift age. This rare specimen contains four fine footprints and part of the fifth; length of stride of these footprints is nineteen

inches; track from heel to toe, eight inches; from first claw to third claw, eight and a-half inches. The extreme depth of the heel of most of these were from one inch to one and a quarter below the ordinary surface of the rock. The stride is so short for such a large bird, that they must have been walking at a very leisurely pace, in fact all the other prints would indicate the same thing. These were found in about the fifth or sixth layer below the alluvial deposit referred to, and have a dip perhaps of about six degrees to southwards. But so far as could be ascertained no "Moa" bones have ever been found, in this vicinity, unbedded in the recent rocks such as that in which the footprints occur.



[illegible]

The accompanying cuts will give a better idea of these, taken from specimens which I dug up myself, also showing *fac simile* casts made from the same specimens, showing the footprints in relief.

The original is now in the museum of the University of California, Berkeley.—*C. D. Voy.*

Geological Examinations in Texas.—After the middle of December of the past year, I examined the Little Wichita, along its whole course from its mouth to its remotest sources, together with all its right and left hand branches. After that I went to the Big Wichita, and traveled over all that region for about one hundred miles, from the mouth of the river and along its branches on both sides.

The time which I consumed in these regions amounted to over six months. The result of my investigations surpassed in scientific aspects all my expectations. I found not only many new plants and animals, consisting of petrified ferns, fishes and reptiles, but discovered a new extinct vegetable and animal world, hitherto wholly unknown in America. According to these petrifications, the whole region spoken of belongs to the transition period, and especially to the permian formation, both the lower and the upper are therein apparent.

In a mineralogical view I found there the following:

A. Rocks—sandstone as well as limestone is abundantly

diffused and eminently suited for building purposes, both on account of their hardness and stratification.

B. Metals—1. Iron ores; *a*, spar iron ore, or spherosiderite, pure and clayey; *b*, brown iron ore; *c*, yellow iron ore, as bean ore and limonite; *d*, hematite and ironglance, or silicate of iron.

2. Copper ores; *a*, malachite; copperglance; *c*, azurite.

3. Zinc ores; *a*, zincspath; *b*, zincblende.

4. Lead ore; as leadglance.

Among iron ores, the pure and clayey spherosiderite appears most frequently. The red and variegated clay strata, often 50 and 60 feet thick, are almost always overlaid with sandstone or limestone; all iron ores are contained in these clay deposits, and laid in compact masses, 2 inches to 2 feet thick, in more or less regular strata or in pockets.

Brown iron ore is seldom deposited as such in clay, but appears mostly from spherosiderite, exposed to the air and weather-beaten. On the other hand, yellow iron ore is found bound together in round pieces, from the size of a pea to that of a pigeon egg, abundant in some places, and is then called bean ore; or it forms hard, brown-red, heavy masses, containing very many animal remains, in which it is named limonite.

Through the influence of succeeding geological periods, the sandstone and limestone covering the clay strata were in some places destroyed; the soft clay laid bare was in the course of time by rain washed away, and thus there were produced the valleys, bluffs, hollows and ravines. The heavy masses of iron ores remained behind, and have by degrees so accumulated that there are stretches a mile wide on which hundreds of tons of iron ore can be gathered on the surface of one acre, without the aid of shovel or pick. When the spherosiderites are disintegrated and washed out they often acquire the appearance of slag, and have therefore formerly been taken for volcanic scoria.

The iron ore of the permian period of north-western Texas is diffused over a surface which extends over more than one hundred miles in length and over fifty miles in width. The outwashed and cleansed mass on the surface is so large that it would suffice to supply the whole United States with iron for ten years.

Copper ore is there often encountered, especially as malachite and copper glance; the latter is often mixed with coal, particularly when the petrified mass is formed from wood, However, I have now here seen these ores in inexhaustible quantities. I found them most abundant on the lands of the Texas Copper Mining and Manufacturing company. Zinc, in the form of zincspar and zincblende, exists in some places; there is also iron ore, especially spherosiderite, containing zinc. Lead is found sparingly injected in spherosiderite and very hard clay masses. I have nowhere

yet found coal deposits in the permian formation, but the permian is bordered on the whole south side by the genuine coal formation, which covers the latter in almost its entire extent. Coal layers two to eight feet thick come to the surface some miles off from the boundary, and it may with certainty be assumed that stone coal can be reached at a moderate depth near the deposits of iron ore of the permian period. If we cast a glance over the mineral kingdom of northwest Texas, and compare the same with that of England, we discover there the same appearances. In this respect Texas is equally favored, while its coal deposits in the earth, together with those of iron ore, embrace a space double that of England.—*Jacob Boll.*

GEOGRAPHY AND TRAVELS.[1]

The Ascent of the Binué, in August, 1879.—Of the few large rivers to be found on the African continent, the Niger and its tributary, the Binué, probably present fewer obstacles to navigation and afford the most uninterrupted means of access to the still unexplored equatorial region. The recent voyage, therefore, of the missionary steamer *Henry Venn*, which succeeded in reaching a point on the latter stream 140 miles further than has ever before been attained by boats is of much importance. We compile the following account of the trip from papers read before the Royal Geographical Society, by Mr. Edward Hutchinson,[2] and before the Berlin Society, by Herr Ed. Robert Flugel,[3] and also from statements furnished by the latter to *Petermann's Mittheilungen.*[4]

Mr. Hutchinson in his preliminary remarks upon the area drained by the rivers Binué and the Shary, discusses the much vexed problem of the identity of the Welle discovered by Schweinfurth, and which he and Keith Johnston believe to flow into the Shary, but which Stanley and Junker consider as belonging to the Congo system.

"The northern and eastern limits of the area drained by these two river systems are now fairly well ascertained. The travels of Petherick, Schewinfurth, Nachtigal, and Dr. Junker, have shown them to be, on the north-east, the ranges which run from the Tibesti mountains, and on the east the ranges which run through Darfur to Mount Baginze and west of the Albert Nyanza, the eastern slopes of which form the gathering grounds of the Bahr el Homr, the Bahr el Gazal, and the White Nile.

"The southern limits of the area we are considering, are as yet unknown. They will probably be found to be ranges of hills of no great elevation, running westwards

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[1] Edited by Ellis H. Yarnall, Philadelphia.

[2] *Proceedings of the Royal Geographical Society*, May, 1880, p. 289.

[3] *Verhandlungen der Gesellschaft für Erdkunde zu Berlin*, Band VII, No. 3, p. 112.

[4] *Petermann's Mittheilungen*, April, 1880, p. 146 with preface, by Dr. E. Behm, p. 145. See also number for June, 1880, for account of the voyage of the *Henry Venn* from the mouth of the Binué to Djen, also by Herr Flugel.

north of the Congo, and ultimately turning north and joining the range of the Cameroons mountains. These ranges or uplands form the northern and eastern watershed of the Congo, the Ogowé, and the Cross rivers.

"The watershed of the Ogowé has been crossed by the traveler De Brazza, at no great elevation, and Keith Johnston considers that the Ogowé gathers its large volume of waters from numerous tributaries, within a radius of a few hundred miles of the coast.

"The Cross river has been supposed to be a branch of the Niger, but it is more probable that, like the Gaboon river, it will be found to be only a large estuary receiving a number of small tributaries from adjacent uplands.

"It will thus be seen that the north-eastern and eastern limits, and possibly also the south-eastern, are mountain ranges of considerable height, and therefore play an important part as gathering grounds for rainfall, and, though we have no exact data as to rainfall, the mass of water which must fall upon them is enormous.

"The size of the Welle, as indicated by Schweinfurth, in its short course from its chief heads, shows the volume falling upon its highest gathering grounds. The drainage of the western slopes of the ranges, whose eastern sides supply the tributaries of the Bahr el Gazal, must furnish a volume equal to that stream—a volume which would be sufficient to account for the difference between the contents of the Welle, as given by Schweinfurth, and those of the Shary, as given by Major Denham, and to produce that vast body of water which floods the depression called the Bodele, crossed by Nachtigal in 1878, and finds a southern outfall in the direction I shall presently allude to.

"According to the testimony of Major Denham, who made his observations on the 24th of June, 1824, the width of the Shary at its mouth was about a half a mile, while its stream had a velocity of something under three miles an hour. This would indicate a stream three times as strong as that of the Welle, and if the average depth of the waters as they flow into Lake Chad be reckoned at ten feet, it would give a volume of 85,000 cubic feet a second, whereas at the very highest reckoning the volume of the Welle is not above 20,000 cubic feet.

"When Barth crossed the Shary in 1852, a much larger quantity of water was being discharged along its system. He crossed the Logon, a western branch or backwater, and further to the east he crossed the main branch at Mélé. The Logon was a large and powerful river, while the main stream contained more water at Mélé than Denham found at the mouth of the Shary.

"This difference in volume is accounted for by the variation in rainfall, 1851 and 1852 must have been seasons of heavy rainfall, for Barth also found a much greater depth of water in the Binué at Tæpe, than was found by our men last year. It is manifest, however, that the system of the river Shary accounts for the drainage of only a portion of this vast area.

"What outfall is there for the rainfall on the western slopes of the ranges to the north of the Congo and the Ogowé? I think it will be seen that the exploration of the Binué throws some light on this question and tends in the direction of the existence of a lake system somewhat similar to that of the Chad.

"The earliest maps of Africa suggest a large sheet of water in the southern half of the area we are considering. Felipe Pigafetta, on information furnished by Duarte Lopez, places it in two degrees north. It is somewhat remarkable that his is the only antique map of Africa which assigns to the Niger its true outlet, and although he falls into the common error of permitting two or three rivers to flow out of the same lake, yet the general features of his map are so near the truth as to suggest that the Portuguese had a fairly correct knowledge of the interior of Africa, but lacked the scientific methods of stating the information they possessed. Coming to later times, we have Piaggia, who places a great sheet of water in lat. 1° S. long. 24° E. It is true that he himself did not see the lake, but only gives the native report. There appears, however, to be no doubt that upon that meridian Piaggia has penetrated further south than any other European. Schweinfurth, moreover, speaks of him as an acute observer, and though his great lake depends on native report, it must not be forgotten that it was native information furnished to men hundreds of miles from the spot which led to the discovery of Tanganyika and the Victoria Nyanza.

"At the geographical council held by Mr. Stanley, at Kafurro, in Karagwe, there was a prevailing opinion that far to the north-west of the Mfumbiro mountains was a great lake to which no Arabs had ever penetrated. These Mfumbiro mountains are well to the south and on the west of the Albert Nyanza, and the direction thus

indicated points to the quarter in which Piaggia places his great lake. It is not impossible, therefore, that there may be in the southern part of the area we are considering, a system not unlike that of Lake Chad, and that consequently no considerable portion of the drainage from the southern hill ranges finds its way north."

The voyage of the *Henry Venn* was made under the direction of the English Church Missionary Society, their agent, Mr. J. H. Ashcroft, being in command. The vessel was built expressly for the navigation of the Niger. She is 120 feet long, 15 feet beam, 6 feet deep and draws 3 feet 6 inches of water on an even keel, with about 60 tons of cargo aboard. After being occupied for some time on the Lower Niger it was not until the flood season of last year that she undertook the ascent of the Binué, and sailed on that duty from Lukoja at the mouth of the river on July 8, 1879.

As far as Djen the river is well known from the previous expedition of 1854. This point was reached on the 20th of August. The river banks here are about six feet high, the river rather shallow. The people were friendly. A very picturesque range of mountains runs parallel with the river here, about two to three miles distant, inhabited, it is said by Herr Flugel, by cannibals. On the 22d they reached Gamadge, on the left bank, a mile or two below Mount Gabriel, to the west. Mount Gabriel is about five hundred feet high and is covered by very high grass in which the few bushes and trees standing on its sides are nearly hidden. The banks of the Binué are frequently higher than the adjacent country which sinks to the foot of the mountains, and is often swampy and covered by the waters in the time of floods.[1] The men came out in great force here armed with shields and spears, and bows and arrows. They salute here by holding up the right arm and putting the left on the stomach.

On arriving a few hours later at a small place called Iangai, they dispatched messengers to the King of Bassama, and on the 23d the King's son arrived with presents of a cow and a bullock. He seemed "a nice quiet sort of person," but the men who accompanied him were wild and fierce, and during the two days they remained here many threatening demonstrations were made. On the 25th they continued up the stream, passing several small towns. "The people did not seem to like the look of the steamer; it was more than they could understand all at once." "This part of the country is very thickly populated, and it would not take many visits to make very good friends of these people. The current is very rapid just above here; river varied in width; for the distance of 500 yards it narrows to about 250 yards wide, then opens out again to 500 or 600 yards; very few trees about here, only a few monkey-bread trees. Came in view of several new ranges of mountains, at a distance of from eight miles, the nearest,

[1] An interesting note on this characteristic feature of African Geography is given by Herr Flugel. *Petermann's Mittheilungen*, April, 1880, p. 148.

to twenty miles the most distant." On August the 26th, messengers arrived on horse-back from the King of Demsar. [Bassama ?] They were dressed in fine scarlet cloth and brought a tusk of ivory. On the 27th they reached the first village of the Bulas.[1]

"I have not seen," Mr. Ashcroft remarks, "any part of Africa so thickly populated as this inhabited by the Bula people. For about twenty-five or thirty miles they are as thick as bees. In fact, since we left Djen, the country is very thickly peopled with fine, strong, warlike, healthy, robust people, that seem to lack nothing but a few more cloths; for they possess cattle, horses, and sheep in abundance, and are everywhere ready to repel invasion, fully armed with spear and shield, or poisoned arrow ready strung, and a quiver full ready for action. They put their hand over their mouths and put it quickly back again, making a shrill noise, 'bla, bla, blu, blu,' in quick succession; some saluted us by holding up the hand, but they never appeared to know what to do, we were so strange to them, coming right into the lion's den; for nothing seeks to pass these hostile Bula villages, nor do I think it possible for any but a good-sized steamer to be able to do this, for thousands of canoes came out during the time we took to pass all these villages. Some villages had 300 or 400 of these canoes, each holding three or four men standing up, with big long paddles, and armed with spears, which they are very expert in throwing, if we may go by what we saw them do when hunting a hippopotamus one day when anchored near while lying off Choma."

"A fine range of mountains on the left bank I called the Buxton mountains, but they are seen to much better advantage near Yola, and are nearer the water. From here they were about nine or ten miles off. Wright range on the right bank, is a splendid range, extending for a long distance, with peaks and terraces from 2000 to 2500 feet, with rugged perpendicular walls of red rock."

On the 28th, another fine range of mountains extending for a long distance along the right bank came in sight.

"Some of the peaks I should think nearly 3000 feet high, the usual height 1500 to 2000; this range extends many miles along, and in some places, near the right bank specially so, just abreast of Yola, with plenty of rock jutting out here and there, of sandstone, much worn. This is Barth's Mount Bagele in all probability." * * "The country which has been, since just above Djen, bare of trees, is now assuming a park-like appearance, with beautiful mountainous scenery on every side, and trees here and there, just like a park at home, and the hills rising from the water side; hitherto there has been more or less plain extending from the river to the foot of the mountains. An artist would have been blessed with the varied play of color, of rocks, trees and bushes, not to mention the rich vegetation, and the deep gullies and weather-worn rocks of many shades of color, some very rugged and bold." * * "Yola stands on rising ground, about three miles from the river, and is a long straggling place, composed of four lots of houses and compounds, *i.e.*, each house surrounded by a piece of cultivated ground, with a fence made of plaited grass, called by the natives, zenana."

Leaving the Bula territory they passed into a country inhabited by the Fulahs. This river grew broad and shallow; the banks swampy to the foot of the mountains, lying in broken ranges and reaching on the north side to from 1000 to 2000 feet in height. On September 2d, they passed with some difficulty, through a narrow channel over rapids, passing Tæpe, and arriving at the confluence of the Faro and Binué. The former appeared to be a shallow stream and was said to be full of rocks. The Binué above this point is much narrower, about two hundred yards wide;

[1] Herr Flugel thinks that about 12° 3′ E. long. on the northern bank, a large tributary, perhaps the Gongola, has its mouth, but he was not able to examine that portion of the shore.

the banks being overflowed at this period for a long distance inland. The Yarita or Blackstock mountain rises abruptly from the plain near here and appears to have been confounded by Dr. Barth with the Atlantika, which is stated by the natives to be a long distance south. The people on this part of the river were found to be friendly, quiet and industrious, and well clad.

The river has many bends, is very rocky, and frequently the navigation is very difficult and dangerous.

The *Henry Venn* reached her furthest point at Gurua, on September 4th, but the launch went eight or nine miles beyond to Ribago, about a mile from a range of mountains named by the party after Baroness Burdett Coutts. "Magnificent mountains, looking in the distance like a large palace with the center of the building higher than the rest. The finest scenery of the whole river was just about here. I was exceedingly sorry to have to turn back, the country being so beautiful; and the people treating us like old friends, not the least alarmed when we approached with the steamer."

The chief of Gurua told them that canoes could only be used during two or three months in the year. The Kebbi, one of the main branches of the Upper Binué was distant about two and a half days by land, and eight days distant the Binué "comes over mountains" in the Gunderi country. On the next day the river beginning to fill rapidly the *Henry Venn* started on her return down the river and reached Djen in three days, and Lukoja on September 27th.

Mr. Hutchinson in calling attention to the statement that the Binué above the junction with the Mayo Kebbi is a small stream and that therefore the Kebbi is the main branch, expresses the belief that the southern portion of Baghirmi is drained by that stream.

"It seems to rise not far from Tuburi, in a large sheet of water which is separated by a flat level of not more than twenty miles from the large ngáljam[1] of Demmo, which according to Barth, is in direct communication with the western branch of the Shary. Dr. Barth says he was persuaded that in less than fifty years European boats would keep up a regular annual intercourse between the great basin of the Chad and the Atlantic. An almost uninterrupted communication has been opened by nature herself, for, from the mouth of the Kwára[2] to the confluence of the river Binué with the Mayo Kebbi, there is a natural passage, navigable without further obstruction for boats of about four feet in depth, and the Mayo Kebbi itself, in its present shallow state, seems to be navigable for canoes, or flat-bottomed boats like those of the natives, which I have no doubt may, during the highest state of the inundation, go as far as Dáwa in the Tuburi country, where Dr. Vogel was struck with that large sheet of water, which to him seemed to be an independent central lake, but which is in reality nothing but a widening of the upper part of the Mayo Kebbi. It is very probable that from this place there may be some other shallow water course proceeding to join the large ngáljam of Demmo, so that there would exist a real bifurcation between the basin of the Niger and that of the Chad. But even if this should not be the case, the breadth of the water-parting between these two basins at

[1] Swamp.—Ed.

[2] The Niger.—Ed.

the utmost cannot exceed twenty miles, consisting of an entirely level flat, and probably of alluvial soil. The level of the Chad and that of the river Binué, near Gewé, where it is joined by the Mayo Kebbi, seems to be almost identical; at least according to all appearance, the Binué at the place mentioned, is not more than 850 or 900 feet above the level of the sea.

"The regular second rise in the Binué which overtook the *Henry Venn* on the 14th of September, would be explained by the draining of the waters through the Mayo Kebbi, caused by the highest rise in the Chad, which occurs in August. This, taken with the vast volume of the water which the rivers pour down, flooding the land for miles, seems to show its connection with a great system.

"Important results to the continent of Africa might follow an effort carefully made to rectify the apparent irregularities of the Shary. If only a portion of the enormous volume of water which is now absorbed and evaporated in tne vast expanse of Lake Chad were turned into the Binué, through the Mayo Kebbi, not only would such steamers as the *Henry Venn* have access to that great lake, but they could probably ascend the Shary and Welle almost up to the territories of Munza, King of the Monbuttu."

Meteorological observations were taken on the *Henry Venn* four times during the day. There were no night records. Owing to the steadiness of the atmosphere, the daily variations of the barometer never amounting two-tenths of an inch when the vessel was at anchor, the approximate elevation of the highest point reached may be stated with some approach to accuracy at 624 feet above the level of the Niger at Lukoja.

This makes the average fall of the river to its mouth fifteen inches per mile.

The maximum of the thermometer was 91°, and the minimum 74°. The daily range amounted to only 3°. The average temperature for the whole period of eighty days was 79°. The thermometer did not rise to 80° in fifty-four days, and only reached 75° in nine days while the highest point was only attained once. Rain occurred on twenty-eight days and lightning on twenty-one days.

MICROSCOPY.[1]

Holman's New Compressorium and Moist Chamber.[2]—In working with living animal forms suitable for the elucidation of some of the principal doctrines of life, any contrivance which will render the study easier, and hence more profitable and economical of time, should be hailed with delight by the working microscopist Such a labor-saving device is represented in the accompanying cut, Fig. 1, of Mr. D. S. Holman's new compressor. This apparatus differs from all other compressors in being so arranged that the mica cover is fixed and immovable, while the lower, thicker plate of glass is moved up and down by means of a screw nut and spiral spring, an arrangement which enables the student to adjust the apparatus so as to apply *with certainty* any degree of pressure upon any soft object without risk of breaking large and expensive cover glasses, crushing the object unex-

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

[2] Advance sheets from Journal Franklin Institute for August, 1880.

pectedly, or injuring high-power lenses. The writer by its means was enabled to study with great deliberation and certainty, the

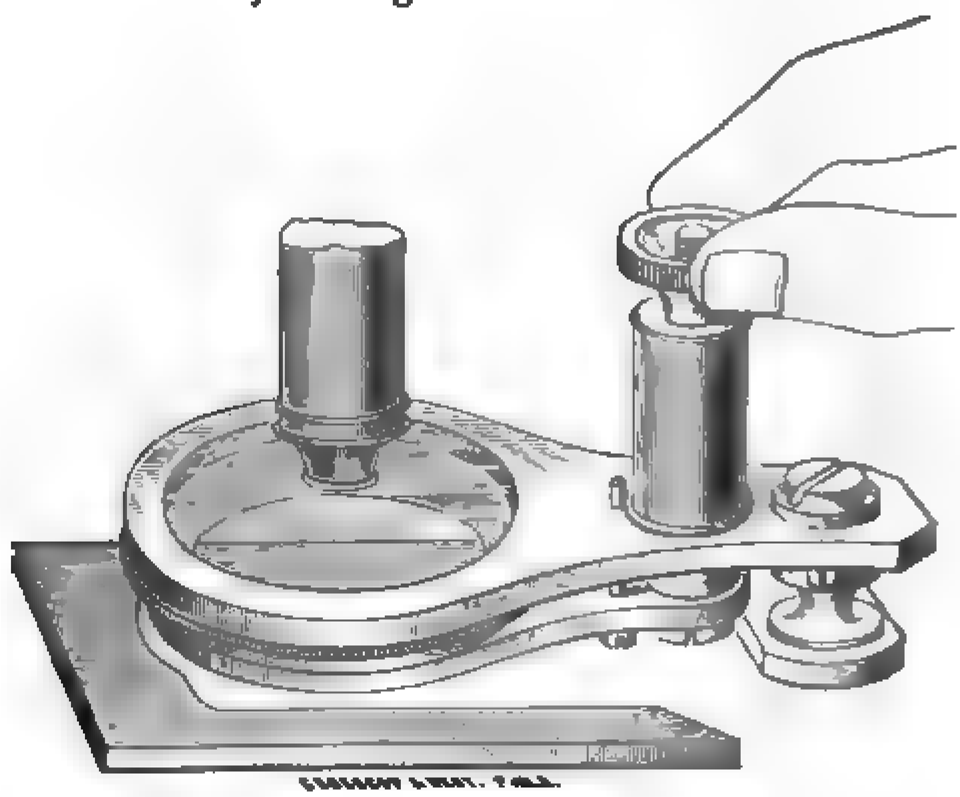

FIG. 1.

internal anatomy of the larva of the plumed crane-fly (*Corethra plumicornis*). In this case the pressure could be so nicely adjusted as not to disturb in the slightest degree the normal physiological actions of the larval fly; the physiological action of the heart could be readily studied, as well as the significance of the so-called apolar ganglion cells of that organ. Every life process, in short, was visible through the transparent body of the creature, so that if *well* studied by the help of this apparatus, the student will have acquired a mental image or epitome of the morphology and physiology of that great group of jointed animals, the insects.

Equally good results were got by its use in studying the embryology of the shad, where it revealed to the writer, and for the

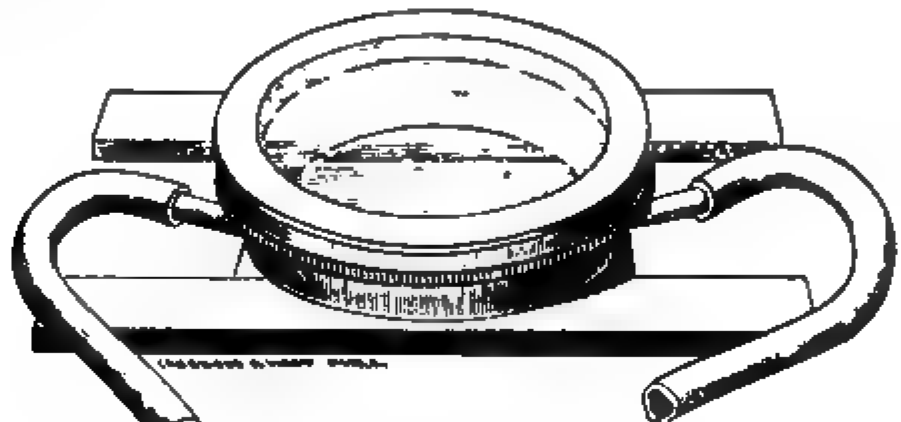

FIG. 2

first time to science, the presence of a so-called polar vesicle in the earliest stages of development.

In Fig. 2 we have a combination of the familiar animalcule cage

and the siphon slide, also designed by Mr. Holman. The edge of the cover or cap is beveled, so that by rotating it against the inflow and outflow tubes of the siphon arrangement, a very convenient and effective compressor is obtained. The apparatus is equally as valuable as the compressor before described, because of the certainty with which one can gauge the amount of pressure which is applied; also on account of the facility with which water may be renewed in it when used as a "moist chamber" for studying growing fungi, without in the slightest degree disturbing these delicate plants. The value of the apparatus is further enhanced by the facility with which it may be used as a siphon slide for keeping aquatic larvæ, worms, etc., alive for a lengthened period for study or exhibition. It is equally useful as a dry compressor for holding, studying and drawing minute soft-bodied insects in the living state. These useful pieces of apparatus should be found upon the table of every working microscopist, where every day's use will demonstrate their indispensibility. It was in one of Mr. Holman's siphon slides, right under the microscope, that the writer successfully hatched young shad, a feat never before performed with the eggs of fishes.—*John A. Ryder.*

METHODS OF DRY MOUNTING.—Slides made of wood are lighter and stronger than glass ones, and look quite as elegant if made of ornamental wood and polished, or covered with fancy papers. In the first place procure some thin boards, about one-sixth or one-eighth part of an inch thick; these should be cut up into strips three inches long and one inch wide, and ground smooth with sand paper. In the center of these slips burn a hole to the required depth by means of a heated iron rod. I consider that this is a very good way of making a cell in the wood, as it leaves the surface black, and if the iron is carefully used it makes the bottom of the cell beautifully even. Into this cell drop a little thin liquid glue (which is made of shellac dissolved in methylated spirit), and with a small brush spread it all over the interior of the cell, and some little distance round the margin. This process has the very desirable effect of rendering the cell damp-proof. For small objects a circular piece of black or dark colored paper should be glued in the bottom of the cell, and the object (carefully dried) should be stuck in the center of the paper disc; if, however, the leaf with fungi has been cut sufficiently large to fill the bottom of the cell the paper circle may be dispensed with altogether. After another process of drying, the thin glass cover may be affixed by means of any of the various cements. * * * I venture to think that this method will be found to be equal, if not in some respects superior, to others in which the cell is built up on the slide, as there is no danger of the cell breaking off when roughly handled. * * * I believe wooden cells are often used for dry objects by many workers, but to those who have not yet given them

a trial, and especially to those who make a special study of that delightful branch of micro-botany, micro-fungi, I hope it will commend itself as a thoroughly efficient and simple method.—*George Clinch, in Science Gossip.*

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SCIENTIFIC NEWS.

— Died, in Beverly, Massachusetts, Count Louis François de Pourtales. Count Pourtales was born in Neufchatel, March 4. 1823. He belonged to the Swiss branch of an old family which has branches also in France, Prussia and Bohemia. He was educated as an engineer, and came to this country about the same time as Agassiz, and became his fellow-worker and pupil. Upon the death of Agassiz the Count was appointed Keeper of the Museum of Comparative Zoölogy, which position he held at the time of his death. He had previously entered the service of the Government in the Coast Survey. His papers on the physical geography of the Caribbean sea and the Gulf stream established his reputation in Europe as well as in America. Through the death of his father he succeeded to his title, and received a fortune which gave him the opportunity of devoting himself wholly to his favorite studies. It is said that his modesty amounted almost to a fault, and that people wondered why a man who was the master of three languages should speak so little. With intimate friends, however, he would converse freely, and never without giving information and amusement. The Count was of strong frame, and his temperate mode of life gave hope of a long period of usefulness. He was stricken with a painful malady, and, after several weeks of great suffering, which he heroically endured, he died. His old friend and preceptor, Prof. Louis Agassiz, died seven years ago.

— The two first parts of a new botanical work by Dr. Dodelport, of Zurich, have just been published by Herr Cæsar Schmidt, of that city. The title of the work is "Illustrirtes Pflanzenleben," and it promises to become one of unusual interest. In Part I the lower fungi are described in a popular manner. The author undertakes to popularize the results hitherto attained in our knowledge of putrefaction and contagion-fungi. He describes their forms, their size, and their manner of propagation; introduces the reader to their mode of life, and points out the danger arising to the human race from these minute organisms. The description is accompanied by two excellent plates, in one of which we recognize a reproduction on a small scale of a plate from the same author's famous "Atlas der Botanik für Hoch und Mittelschulen." Another chapter treats of miasma and contagions, and gives a

complete account of the present state of our knowledge of infection-fungi. Part II is devoted to carnivorous plants, and is even more generally interesting perhaps than the first. The work is profusely illustrated with the author's original drawings. Altogether it is sure to form a very welcome and valuable addition to botanical literature.—*Nature.*

— Some new experiments with regard to the influence of electricity on Bacteria have been published by Prof. Cohn, who adopted the method of sowing with Bacteria a sterilized mineral nutritive solution, subjecting them to electric currents, and noting the results. A Marie-Davy flask-element he finds to exert (according to strength of current) either no influence on the increase of Bacteria, or merely a retardative influence. On the other hand, the current from two powerful elements sterilized the nutritive solution completely at the positive pole in twelve to twenty-four hours, so that afterwards the Bacteria introduced did not increase. At the negative pole the action was weaker, the liquid not completely sterilized. At neither of the poles were the Bacteria killed, and when brought into another nutritive liquid they developed normally; on the other hand, yeast cells and mycelium fungus brought into the liquid that was sterile for Bacteria increased plentifully at the positive pole. A battery of five strong elements killed the Bacteria distributed in the liquid within twenty-four hours, and sterilized the liquid of both poles.—*English Mechanic.*

— The Eleventh Annual Report of the American Museum of Natural History in the Central Park, New York, states that the institution is now entirely out of debt, the members of the Board of Trustees having subscribed $27,250 to cover the indebtedness, which with the donations of other friends of the museum, leaves a small balance in the treasury. The city paid during the year, over $10,000 towards the maintenance of the museum. Valuable and costly additions in zoölogy, geology and anthropology have been made, while important additions have been made to the libraries deposited for safe keeping. Students from a number of institutions visit the libraries and collections; besides this efforts will be made to render the museum a direct benefit to the teachers and pupils of the public schools. We are glad to watch the development of this great and growing museum, and hope it will contribute still more decidedly to the advancement as well as the diffusion of science in New York, and be a means of rational enjoyment to the citizens.

— Mr. E Whymper is reported to have successfully accomplished the ascent of Chimborazo, the loftiest mountain in the Cordilleras of Ecuador. He took ten days in getting from the Rio Bamba two-thirds of the way up to the summit, and the

difficulties encountered were greater than was expected, owing to the wind and the rarefaction of the air. On the top of the mountain the thermometer showed a temperature of 11° Fahr There is no crater at all, but two peaks, both of which Mr. Whymper ascended; he found that the higher one was at an elevation of 21,982 feet above the sea-level, or nearly 12,000 feet above the valley of Quito.—*English Mechanic.*

— The American Academy of Arts and Sciences celebrated the first centennial since its foundation in Boston, on the 26th of May. This is the oldest scientific society in America next to the American Philosophical Society of Philadelphia. The formal exercises were held at the Old South Church, where Franklin was baptized; addresses being made by Hon. R. C. Winthrop, Ex-president Asa Gray and others. At the collation in the rooms of the academy, numerous delegates from home and foreign societies expressed their congratulations and good wishes. A large attendance crowded the hall of the academy.

— Died on the 5th Aug., Alvah James Ibbotson, aged 53 years. Mr. Ibbotson was a lithographic artist who stood at the head of his profession in this country. Most of the best plates of vertebrate fossils published by Leidy and Cope were his work, besides many plates of the fossil invertebrata published by Meek, White and others. He was remarkable for accuracy and artistic finish, as well as rapidity of execution. Mr. Ibbotson was a native of England, and had been in the employ of T. Sinclair and Sons, of Philadelphia, for twenty-five years.

— A German naturalist, in the course of inquiries as to the phosphorescence of the sea, has found that the phenomenon occurs whenever sea fishes are brought into a three per cent. salt solution. The luminosity begins apparently in the eyes, spreads over the whole fish, and increases day by day. The fish after some time seems luminous throughout. The phosphorescent substance is a kind of mucus, which appears dirty-white by day, and shines in the dark.

— Mr. J. A. Lintner has received the appointment of State Entomologist, the office, discontinued after Dr. Fitch's death, having been again established. The appointment is a most fitting one, as Mr. Lintner is well known as an excellent observer and clear writer on economic entomology, besides having done a high order of work in general entomology.

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THE FOOD OF THE DARTERS.

BY S. A. FORBES.

WHAT the humming-birds are in our avifauna, the "darters" are among our fresh-water fishes. Minute, agile, beautiful, delighting in the clear, swift waters of rocky streams, no group of fishes is more interesting to the collector; and in the present state of their classification, none will better repay his study. Notwithstanding their trivial size, they do not seem to be *dwarfed* so much as *concentrated* fishes—each carrying in its little body all the activity, spirit, grace, complexity of detail and perfection of finish to be found in a perch or a "wall-eyed pike."

To the entertaining and instructive account of the sub-family given by Jordan and Copeland in former numbers of the NATURALIST,[1] I propose to add a few notes on their food, based upon a study of the contents of seventy stomachs, and to point out some of the correlations between structure and habit, with a view to accounting for the origin of the group.

These seventy specimens represented fifteen species, collected in all parts of Illinois, in several months of four successive years. They indicate much more than their number would imply, since from those collected at each time and place, as many were commonly studied as were necessary to give a full idea of the food of the species then and there. The different individuals from the

[1] "Johnny Darters." By D. S. Jordan and H. E. Copeland. AM. NAT., Vol. X, No. 6, June, 1876, pp. 335–341.
"The Sand Darter." By D. S. Jordan and H. E. Copeland. AM. NAT., Vol. XI, No. 2, Feb., 1877, pp. 86–88.

same date and locality usually agreed so closely in food, that the study of from two to five gave all the facts obtainable from several times as many. The data here given, therefore, really exhibit the food of the family at different seasons in twenty-nine localities within the State.

The genus *Pleurolepis* is comparatively rare in Illinois, as there are few of the sandy streams in the State, which it inhabits. Seven individuals were examined—four of *P. pellucidus* and three of *P. asprellus.* The food of these specimens was remarkably uniform—the only elements found being the larvæ of small diptera and Ephemerids. Eighty-one per cent. of the food of all consisted of the larva of Chironomus,[1]—a small, gnat-like insect,—twelve per cent. of the larva of other small diptera, and the remaining seven per cent. of Ephemerid larvæ (May flies).

Twelve specimens of the genus *Alvordius* were studied—seven of *maculatus* and five of *phoxocephalus.*[2] These represented five different localities and dates. This is a larger species than the preceding, and to this fact is probably due the predominance (seventy-five per cent.) in its food of the larvæ and pupæ of May flies (Ephemeridæ). These included four per cent. of the larvæ of *Palingenia bilineata* Say, one of the largest Ephemerids in our streams. The remaining kinds were larvæ of dragon flies (Agrionini), four per cent.; larvæ of Chironomus, seven per cent., and *Corixa tumida* Uhl., thirteen per cent.

The genus *Boleosoma*, regarded by Dr. Jordan as the typical darter, was represented by twelve specimens from eight localities—nine of *maculatum*, two of *olmstedi* and one of *camurum.*[3] These specimens show but slight food differences from other darters of similar size; the only notable variation being the appearance of fifteen per cent. of case-worms (larvæ of Phry-

[1] The larvæ of Chironomus are among the most important elements of fish food in our waters, appearing in abundance in the stomachs of the young of a great variety of species. They have been too little studied in this country to allow specific determination.

[2] The classification used in this paper is that of the second edition of Jordan's Manual of Vertebrates.

[3] *Boleosoma maculatum* and *B. olmstedi* should undoubtedly be united. Specimens in the laboratory collection present the extremes of both forms, together with numerous intermediate stages of each character used to distinguish them.

This whole group exhibits a surprising variability, perhaps due to its comparatively recent origin.

ganeidæ). Sixty-six per cent. of the food was Chironomus larvæ, seven per cent. larvæ of other minute diptera (including Simulium), and the remaining eight per cent. was larvæ of small Ephemerids.

I studied the food of two specimens of *Pœcilichthys variatus*, four of *P. spectabilis* and two of *P. asprigenis*—making eight of the genus, representing six localities. Fifty-eight per cent. of small larvæ of diptera (forty-nine per cent. of Chironomus), thirty-two per cent. of larvæ and pupæ of small Ephemerids, and ten per cent. of case-worms made up the entire bill of fare.

Percina caprodes, the largest of the group, departs from all the foregoing species by the introduction of crustacean food—thirty per cent. of Entomostraca and three per cent. the smallest of our Amphipoda, *Allorchestes dentata* (Smith) Faxon. Most of the Entomostraca were *Cladocera*, including Daphnia, Eurycercus and Daphnella.[1]

Here occurred the only instance of molluscan food in the group. One specimen had taken a few individuals of *Ancylus rivularis* Say. Reduced ratios of Chironomus and Ephemerid larvæ, and a few *Corixa tumida* complete the list.

Of *Nanostoma zonale*, less common than the others, but two individuals were examined, and these had eaten nothing but larvæ of small diptera, including sixty-five per cent. of Chironomus.

Six specimens of *Etheostoma flabellare* var. *lineolata*, from four localities, had eaten sixty-one per cent. of Chironomus larvæ, twenty-seven per cent. larvæ of small Ephemerids, and twelve per cent. of Copepoda (Cyclops).

Boleichthys elegans, found only in the southern part of the State (three specimens examined), had eaten only dipterous larvæ (thirty-seven per cent.) and Ephemerid larvæ (sixty-three per cent.). This is a larger, heavier species than most of the others, and, therefore, like Alvordius, prefers Ephemerids to gnats.

Last and least comes *Microperca punctulata*, represented by nine specimens from four localities in Northern Illinois. This smallest of the darters shares with Percina, the largest, the peculiarity of crustacean food, which made up sixty-four per cent. of the total. The principal kinds were Cyclops, Chydorus, young

[1] Daphnella was found in a Percina from the Calumet river, at South Chicago, but not in condition to permit the determination of the species.

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Gammarus fasciatus Say, and young *Crangonyx gracilis* Smith. The remaining elements were Chironomus larvæ (thirty-four per cent.) and a trace of Ephemerids (two per cent.).

It will be seen that the family, taken as a whole, divides into two sections, distinguished by the presence or absence of crustacean food. This is easily explained by the fact that Percina and Microperca range much more freely than the other genera—being frequently found among weeds and Algæ in comparatively slow water with muddy bottom, while the others are rather closely confined to swift and rocky shallows.

In discussing the food of the whole group, taken as a unit, it may best be compared with the food of the young of other percoids. It is thus seen to be remarkable for the predominance of the larvæ of Chironomus and small Ephemeridæ—the former of these comprising forty-four per cent. and the latter, twenty-three per cent. of the whole food of the seventy specimens. In young black bass (*Micropterus pallidus*) on the other hand, the averages of nine specimens, ranging from five-eighths inch to one and a half inches in length, were, in general terms, as follows: Cladocera forty-two per cent., Copepoda seven per cent., young fishes twenty per cent., Corixa and young Notonecta twenty-nine per cent., and larval Chironomus only two per cent. The search for the cause of this difference leads naturally to an examination of the whole economy of these little fishes, and opens up the question of their origin as a group.

The close relation of the Etheostomatinæ to the Percidæ proper, requires us to believe that the two groups have but recently diverged, if, indeed, they are yet distinctly separate.

We must inquire, therefore, into the causes which have operated upon a group of percoids to limit their range to such apparently unfavorable situations, to diminish their size, to develop unduly the paired fins and reduce the air-bladder, to remove the scales of several species more or less completely from the head, breast, neck and ventral region, and to restrict their food chiefly to the few forms mentioned above.

No species can long maintain itself anywhere which cannot, in some way, find a sufficient supply of food, and also protect itself against its enemies. In the contest with its enemies it may acquire defensive structures or powers of escape sufficient for its protection, or a reproductive capacity which will compensate for

large losses, or it may become adapted to some place of refuge where other fishes will not follow. What better refuge could a harrassed fish desire than the hiding places among stones in the shallows of a stream, where the water dashes ceaselessly by with a swiftness few fish can stem? And if, at the same time, the refugee develops a swimming power which enables it to dart like a flash against the strongest current, its safety would seem to be ensured. But what food could it find in such a place? Let us turn over the stones in such a stream, sweeping the roiled water at the same time with a small cloth net, and we shall find—larvæ of Chironomus and small Ephemerids and other such prey, and little else; food too minute and difficult of access to support a large fish, but answering very well if our immigrant *can keep down his size.* Here the principles of natural selection assert their power. The limited supply of food early arrests the growth of the young; while every fish which passes the allowable maximum is forced for food to brave the dangers of the deeper waters where the chances are that it falls a prey. On the other hand, the smaller the size of those which escape this alternative, the less likely will they be to attract the appetite of the small gar or other guerilla which may occasionally raid their retreat, and the more easily will they slip about under stones in search of their microscopic game.[1]

Like other fishes, the darters must have their periods of repose, all the more urgent because of the constant struggle with the swift current which their habitat imposes. Shut out from the deep still pools and slow eddies where the larger species float suspended in mid stream, they are forced to spend their leisure on or beneath the bottom of the stream, resting on their extended pectorals and anal, or wholly buried in the sand. Possibly this fact is correlated with the absence or rudimentary condition of the air-bladder; as it is a rule with many exceptions—but still, probably, a rule—that this organ is wanting in fishes which live chiefly at the bottom.

Doubtless the search for food has much to do with this selection of a habitat. I have found that the young of nearly all species of our fresh-water fishes are competitors for food, feeding almost entirely on entomostraca and the larvæ of minute

[1] In Boleosoma, which is normally scaled in front of the dorsal fin, we often find the skin of this region bare in large specimens, and showing evident signs of rubbing.

diptera.[1] As a tree sends out its roots in all directions in search of nourishment, so each of the larger divisions of animals extends its various groups into every place where available food occurs, each group becoming adapted to the special features of its situation. Given this supply of certain kinds of food, nearly inaccessible to the ordinary fish, it is to be expected that some fishes would become especially fitted to its utilization. Thus the Etheostomatinæ as a group are explained, in a word, by the hypothesis of the progressive adaptation of the young of certain Percidæ to a peculiar place of refuge and a peculiarly situated food supply.

Perhaps we may, without violence, call these the mountaineers among fishes. Forced from the populous and fertile valleys of the river beds and lake bottoms, they have taken refuge from their enemies in the rocky highlands where the free waters play in ceaseless torrents, and there they have wrested from stubborn nature a meagre living. Although diminished in size by their continual struggle with the elements, they have developed an activity and hardihood, a vigor of life and glow of high color almost unknown among the easier livers of the lower lands.

The appended table will facilitate a comparison of the records of the different genera. The percentages were obtained by estimating carefully the ratios of each element of the food of each individual, and averaging these ratios for all the individuals of a species:

DETAILS OF THE FOOD OF THE ETHEOSTOMATINÆ.

	Pleurolepis	Alvordius.	Boleosoma.	Pœcilichthys.	Percina.	Nanostoma.	Etheostoma.	Boleichthys.	Mikroperca.
Number of specimens.....	7	2	12	8	11	2	6	3	9
I. MOLLUSCA........					01				
Ancylus rivularis Say.....					01				
II. INSECTA	100	99	96	100	65	100	88	100	36
1. Diptera..............	93	07	73	8	43	100	61	37	34
Undetermined larvæ ...	2	0	07	09	02	35		0	
Chironomus larvæ	81	06	66	49	41	65	6	27	34
" pupæ.....									
2. Hemiptera...........		13			05				
Corixa...............		13			05				
Undetermined.......					03				
Larvæ.............		07			02				
C. tumida Uhl.......		06							

[1] The Catostom[at]idæ (suckers) are an exception to this rule, feeding when young chiefly on Algæ and Protozoa.

	Pleurolepis.	Alvordius.	Bolesoma.	Poecilichthys.	Percina.	Nanostoma.	Etheostoma.	Boleichthys.	Microperca.
3. Neuroptera	07	79	23	42	17		27	63	02
Ephemeridæ	07	75	08	32	09		27	63	02
Pupæ		08		14					
Larvæ	07	63	08	18	09		27	63	02
Palingenia		04							
Agrionini (pupæ)		04							
Phryganeidæ (larvæ)			15	10	08				
III. CRUSTACEA		01	04		33		12		64
1. Amphipoda					03				12
Gammarus, yg.									06
Crangonyx "									06
Allorchestes dentata Sm.					03				
2. Ostracoda					01				06
Cyprididæ					01				06
Undetermined					01				
Cypris									
3. Cladocera					24				27
Undetermined					05				
Daphniidæ					06				
Daphnia					07				
Sididæ					05				
Daphnella					05				
Lynceidæ					01				03
Chydorus									24
Eurycercus					01				
4. Copepoda		01	04		05		12		19
Cyclops		01	04		05		12		19
Confervoid Algæ					01				

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ON THE FORMER EXTENT OF THE TRIASSIC FORMATION OF THE ATLANTIC STATES.[1]

BY ISRAEL C. RUSSELL.

NEARLY two years since I read a paper before the New York Academy of Sciences, on the Physical History of the Triassic Formation in New Jersey and the Connecticut valley,[2] in which many reasons were given for concluding that the Triassic rocks of these two regions were detached portions of one estuary formation.

As several papers have been published relating to the Triassic rocks of the Atlantic States since my essay was written, increasing our knowledge of the subject, and as my interpretation of the geological records has not been accepted by some geologists, I

[1] Read before the New York Academy of Sciences, March 22, 1880.

[2] Annals of the N. Y. Acad. of Sci., Vol. 1, No. 8 (1878), pp. 220–254.

take the present opportunity to briefly restate the substance of my former paper which seems to have been partially misunderstood, together with a brief review of the evidence that has since been gathered.

The broad generalization advanced in the essay mentioned above, was, that all the detached areas of Triassic rocks, from South Carolina northward to Connecticut and Massachusetts, are portions of one great estuary deposit, which has been broken up into separate areas by upheaval and denudation. The immediate aim of the paper, however, was to prove the former connection of the Triassic rocks of New Jersey with those found in the Connecticut valley. The conclusion arrived at from the study of the rocks of these two areas, was, that they are the marginal portions of an estuary deposit, the central region having been subsequently upheaved and greatly eroded. The Triassic rocks in this region thus fill a synclinal trough, the longer axis of which has been upheaved into a broad anticlinal. The facts that lead to this conclusion may be briefly stated as follows:

First. The Triassic rocks in New Jersey dip to the westward at an average angle of about fifteen degrees, while the corresponding beds along the Connecticut river are inclined to the eastward at a somewhat larger angle; thus suggesting that they are portions of one great anticlinal.

Second. Each area is an incomplete estuary formation, having only one line of shore deposits. This is shown in the case of the New Jersey area by the fact that all along the line of bluffs bordering the formation on the west occurs a coarse conglomerate which we have shown to be a shore deposit, derived from the bluffs of crystalline rock to the westward. In the finer sandstones and shales associated and interstratified with this conglomerate are ripple marks, sun cracks, raindrop impressions and the footprints of animals, proving beyond question that this was the shore of the basin in which the Triassic rocks were deposited. Throughout the eastern margin of the New Jersey area, which is sharply defined along the western bank of the Hudson from Jersey City northward to Stony Point, these indications of shore conditions are entirely lacking, in their stead there are sandstones, slates and shales of the character of ordinary off-shore deposits. The trap rock forming the Palisades will be noticed farther on.

Crossing to the Connecticut valley we find this order reversed; on the eastern margin of this area the coarse conglomerates again occur, together with an abundance of all the other proofs of shore conditions we have mentioned; on the western margin the rocks have been formed of sand and mud deposited at a distance from the shore, and are without sun cracks, footprints, etc.; these beds correspond with the sedimentary rocks in the escarpment along the western shore of the Hudson. From these facts it seems perfectly justifiable to conclude that the variegated conglomerate bordering the New Jersey area on the west, corresponds in character and position with the coarse conglomerate occurring along the eastern margin of the Connecticut River region, thus mapping out portions of the eastern and western shores of the estuary in which the Triassic rocks were deposited.

Thirdly. The occurrence of an outlying mass of Triassic beds in the towns of Southburg and Woodbury, Conn., lying between the two great areas, also favors the conclusion that the sandstones and shales of New Jersey and the Connecticut valley were once united. This little oasis in the valley of the Housatonic, is but six or seven miles long by two broad, and is separated from the Connecticut valley area by fifteen and from the Hudson by forty miles of crystalline rock.[1]

Fourthly. The topographical features along the western margin of the New Jersey area and the extension across the Hudson of the line of bluffs which border the formation in New Jersey, as stated on page 21 of the writer's previous essay (page 241 of the Annals), also indicates that the Triassic rocks of New Jersey at one time followed the course of this old shore line and extended eastward of the Hudson.

Fifthly. The striking analogy that exists in the arrangement of the hills of trap found in these Triassic areas was also pointed out in the paper mentioned above. Nearly all the igneous rocks found in New Jersey and the Connecticut valley have been formed as sheets of molten matter intruded between the layers of sedimentary rock and have cooled and crystallized in that position. In the Connecticut valley these sheets of trap dip eastward at the same angle with the sandstones and shales, and present a bold escarpment to the westward; the ends of the long ridges are

[1] Percival's Geo. Rep. of Conn., 1842, p. 410. Also Annals of N. Y. Acad. of Sci., Vol. 1, No. 8 (1878), p. 240.

usually bent eastward so as to give them a "canoe-shape." In New Jersey the sheets of trap are inclined to the westward at an average angle of about fifteen degrees, and present their mural faces to the eastward, as in the Palisades along the Hudson. The trap ridges in New Jersey are also canoe-shaped, but have the ends bent to the westward.

From the study of these trap sheets we may derive important conclusions in reference to the former thickness and extent of the sedimentary rocks with which they are associated. We have previously shown that the long mountain-like ridges giving variety to the landscape in the Triassic areas of New Jersey and the Connecticut valley, are the outcropping edges of sheets of trap that have altered and metamorphosed the stratified rocks both above and below them.[1] From the slope which these outcropping sheets still show—to the westward in New Jersey and eastward in the New England area—it is evident that they were at one time inclosed in sedimentary strata, which have since been eroded away. That these sheets of trap did not reach the surface of the sedimentary beds is also evident from the fact that the molten material did not overflow and form table-lands, like those so common in New Mexico and other portions of the far West. On the First mountain, at Plainfield, New Jersey, as exposed along the Johnston drive, the baked and altered shale is still to be seen on the top of the trap ridge, three hundred feet above the general level of the surrounding plain; here we know that the trap ridge was entirely inclosed in beds of shale and sandstone, and at the very least three hundred feet of sedimentary beds have been removed by denudation. Extending the same reasoning to the Palisade range, we find that it too is a sheet of trap that cooled between strata of shale and sandstone; this conclusion is also borne out by the nature of the trap forming the Palisade range, which is dense and compact, showing that it cooled under pressure. This ridge of trap presents a continuous outcrop from Bergen Point, where it is but a few feet above tide water, northward to Haverstraw, when it attains an elevation of over a thousand feet. Are we not safe in concluding from this evidence that the sedimentary beds were once more than a thousand feet thick along the western bank of the Hudson, and that these same

[1] On the Intrusive Nature of the Triassic Trap sheets of New Jersey. Amer. Jour. Sci., Vol. XV, April, 1878.

strata must have extended on to the eastward? Opposite New York city fully three hundred feet of sandstone and slate is exposed beneath the trap, their broken edges forming the shore of the Hudson at Weehawken. It is to be remembered in this connection also, that these beds were off-shore deposits and had an inclination of fifteen degrees to the westward.

Sixthly. If we could arrive at definite results in reference to the present rate of erosion of the Triassic rocks, we could form more accurate conclusions as to the former thickness of this formation. We know, however, that the present waste, although the rocks are but little elevated above the sea, is very rapid. Composed of soft shale and sandstone, and highly inclined, these rocks present the most favorable conditions for rapid erosion; if these rocks have been exposed to subaerial denudation for a long time, it follows that an immense amount of material must have been removed.

The present drainage of the country shows that the upheaval of the Triassic beds was extremely gradual, and hence that they have been exposed to denudation for ages. The Delaware, for instance, flows at right angles to the strike of the rocks, and has carved out a broad *anticlinal* valley, about thirty miles in length, through the shales, sandstone and trap sheets of the Triassic. From this we must conclude that the Delaware flowed eastward through this region before the rocks were upheaved, and that the elevation of the beds went on so slowly that the river was enabled to cut out its channel as fast as the rocks were brought within its reach. The Susquehanna, the Potomac and other rivers to the south, also bear evidence to the slowness with which the Triassic rocks were elevated, and consequently to the great lapse of time during which they were exposed to subaerial erosion. The deep cañon-like valley of the Hudson, now partially filled, bears evidence of the same nature. No one who does not believe that the surface of the earth has always been as we see it to-day, can resist the conclusion that the Triassic rocks must at one time have had a very great thickness. The problem of measuring the former extent and thickness of the Triassic rocks in feet is far from being determined; we can only conclude from the above considerations, as the time has been long and the rate of erosion rapid, that their former thickness must have been very great.

The material removed from the region separating the two Tri-

assic areas under discussion, must have been composed of sandstone, slate and shale like the escarpments bordering the denuded area on either side, but did not include beds of trap, for as we have already shown the trap ridges are intrusive sheets derived from fissures in the crystalline rocks beneath the regions where they occur.

In my previous essay the statement is made that if faults do not exist in the Triassic beds of New Jersey, that we cannot reckon their thickness at less than 25,000 feet. Under the same supposition the Triassic formation in Pennsylvania have been calculated to be 51,500 feet thick. In the notice of my paper which appeared in the *American Journal of Science*,[1] the first three objections to my conclusions are based on the misconception of this statement. As to the fourth objection, that the "northern limit of the Connecticut valley sandstone area is *north of the northern* limit of the New Jersey. The New Jersey area cannot, therefore, be on the opposite margin of the sandstone region to that of the Connecticut valley," the fact is overlooked that the relative position of these two areas has been determined by the direction of the axis of upheaval of the central region and by the accidents of erosion. Were the Triassic rocks in New Jersey entirely removed, those found to the southward, in Pennsylvania and Virginia, would still be portions of the western margin of the deposit, opposite to that found in the Connecticut valley.

In objection number five of the review, the sweeping statement is made that "no evidence of such an anticlinal, or of the supposed amount of erosion, exists excepting this—that the sandstone of the Connecticut valley dip eastward, and that of New Jersey, situated wholly to the south of the southern limit of the Connecticut valley area, dip northwestward, at the angle stated." The only reply that can be made to this, is simply to refer to the remaining lines of evidence converging on the same point.

It is puzzling to know how "violent floods of the Connecticut river, enlarged for a part of the time by the waters and ice of a semi-glacial era" could spread out wedge-shaped masses of coarse conglomerate along the eastern margin of the Triassic formation, the material forming the conglomerate being clearly derived from the shores of crystalline rock against which the bases of these wedge-shaped masses rest. As we go westward from the old

[1] *Amer. Jour. Sci.*, April, 1879, pp. 328–330.

shore line these beds of conglomerate thin out and pass into the finer off-shore deposits; associated with the conglomerate we also find an abundance of footprints, rain-drop impressions, etc. On the western margin of the same area these proofs of shore conditions are wanting. If this is a river, or a narrow estuary deposit we should expect to find somewhat similar strata on each side of the valley, and that the material forming the rocks should become coarser as we go northward, which as the geological surveys show is not the case; then, too, what river with floods and ice-rafts spread out the Triassic beds in New Jersey, which extend in one unbroken area far into Virginia, with the same structural peculiarities as are found in the Connecticut valley but reversed in their relative position.

Since my essay on the Physical History of the Triassic Formation was written, an interesting and valuable paper on the "Mesozoic Formation of Virginia"[1] has been published by M. O. J. Heinrich, in which many facts are given that have a direct bearing on the question of the former extent of the Triassic formation. The map accompanying this essay gives the position of the detached areas of Triassic rocks in Virginia and North Carolina, together with the dip of the beds, and suggests very strongly that the separate patches were once united. This conclusion presented itself to Mr. Heinrich also, as on page 23 of his paper we read, "the destruction of a connection formerly existing between all the Mesozoic deposits along the Atlantic States might, therefore, be attributed to a slow, an unequal rising of the Eozoic rocks after the deposition of the former upon the uneven floor of the latter, noticed in the anticlinal of the latter, and producing an unequal denudation of the Mesozoic deposits." In the carefully-prepared section of the Richmond coal basin, published with this paper, we find a rapidly-alternating series of sandstones, shales and coal, 1518 feet thick, including a coarse conglomerate thirty-six feet thick at the bottom of the series. This section shows that the conditions at the time of the deposition of these beds was not unlike those now prevailing at the northern end of the Bay of Fundy, where the Tantra marshes are forming.

Another paper on the "Mesozoic of Virginia," by Prof. Wm. M. Fontaine, published in the *American Journal of Science* about a year since,[2] contains much interesting and valuable matter, but

[1] Transactions Amer. Inst. Mining Engineers, 1878.

[2] *Amer. Jour. Sci.*, January, 1879.

arrives at conclusions in reference to the formation of the Triassic conglomerates, the climate of the Triassic period, etc., that seem at variance with the facts, at least as presented in the northern areas of Triassic rocks. The conclusion that the conglomerates are of glacial origin, as also suggested by Prof. Dana,[1] is not sustained by the structure of the variegated conglomerate in New Jersey.

The view that the Appalachian Mountain region was of sufficient height to become covered with perpetual snow, and give rise to glaciers which terminated in the sea, and brought down as moraines the material forming the Triassic conglomerates, and also that the paucity of animal remains in the Triassic rocks is due to the low temperature of the water, owing to the supposition that "the Mesozoic area was fed by the cold waters issuing from the ice and snow of the mountains," is open to several serious objections:

First. The conglomerate, at least in New Jersey and the Connecticut valley, is of the nature of an ordinary shore deposit, formed mostly at the mouths of streams.

Second. The boulders in this conglomerate are smoothed and rounded, but do not show grooves, scratches or planed surfaces like the stones to be found in a moraine.

Thirdly. The fossil plants occurring in these rocks are ferns, cycads, equiseta and coniferous trees of the Araucárian family, these are found from North Carolina northward at least as far as Connecticut and Massachusetts; the home at the present day of the plants belonging to these families, especially of the Cycads and Araucarias, is in tropical and sub-tropical regions.

Fourthly. There was an abundance of reptilian life in Triassic times, as is shown by the great number of footprints found both in New Jersey and the Connecticut valley; reptiles of large size also lived as far northward as the Prince Edward islands. All the larger reptiles of the present day are confined to the warmer regions of the globe, and are mostly found within the tropics. We can hardly believe that the gigantic reptiles of the Triassic age were so different in habits from their modern representatives that they could find a congenial home along shores that were covered with ice, or in waters derived from the melting of glaciers in which icebergs were floating.

[1] *Amer. Jour. Sci.*, April, 1879, p. 330.

The absence in the Triassic rocks of the peculiar markings that are made in soft mud when it freezes, and which are as capable of being preserved as are rain-drop impressions or footprints, is another although a negative indication that there was a mild climate in the Eastern States during the Triassic period.

Then, too, there was not a "paucity of animal life" in Triassic days, as thousands of footprints show; the waters of the estuary were also inhabited by immense numbers of fishes, some of them of considerable size. As to the absence of molluscan life owing to the coldness of the waters, we know that many species of Arctic shells are found in the mud at the foot of the glaciers that terminate in the sea in high latitudes, and that the same and allied species are found in the glacial clays both of Europe and America, thus showing that the presence of ice could not account for the absence of molluscan remains in the Triassic formation. The absence of shells in these rocks seems due to the fact, long since pointed out by Sir H. De la Beche,[1] that animals which live on the sea bottom cannot exist upon a bottom of red mud, and that the presence of peroxide of iron in the waters is fatal to animal life; the presence of peroxide of iron in the rocks will also promote the rapid decomposition of such organic remains as may become imbedded in them. All who have wandered along the shores of the Bay of Fundy, where the bottom is composed of red mud, will remember how destitute they are in mollusks, radiates and crustaceans, the waters are inhabited, however, by great numbers of fishes, belonging, I believe, to a limited number of species. Thus in almost every particular, the study of the present condition of the Bay of Fundy furnishes us with the key with which to unlock the history of the Triassic formation.

The information added by the papers of Mr. Heinrich and Prof. Fontaine, tends to confirm the conclusion that the Triassic rocks in the Atlantic States were formed in one estuary, in the northern end of which sandstone and shales were deposited, being subjected to a greater subsidence than the southern extremity, where the shores were low and favorable for the accumulation of carbonaceous mud and peat.

As the determination of the age of the rocks in question from the fossil plants they contain, has led to widely varying results,

[1] Memoirs of the Geological Survey of Great Britain, Vol. I, p. 51.

we have continued to call them Triassic. If the view here presented of their former extent is sustained, it is evident that the separate members are of one age, differing in their lithology and fossils according to the various conditions under which they were deposited.

NOTE.—Although the conclusions given in my former paper were arrived at independently, I find that the same explanation of the dip of the rocks has presented itself to others. Prof. Hitchcock in his work on the "Ichnology of Massachusetts," p. 14, in speaking of the opposite dip of the beds in New Jersey and the Connecticut valley, says, "It looks rather as if an anticlinal axis or elevation between them, had been concerned in the tilting of both." Prof. Kerr, in his report on the geology of North Carolina, page 141, accounts for the separation of the Deep and Dan river Triassic areas by the upheaval of the region lying between, and the removal of the Triassic beds by denudation, the parts remaining are the fringing portions of a great anticlinal. Prof. Bradley, in an article "On the Geological Chart of the United States east of the Rocky mountains" (*Amer. Jour. Sci.*, Vol. XII, p. 289), favors Prof. Kerr's conclusion and suggests that the numerous trap dikes intersecting the metamorphic rocks of North Carolina, South Carolina, Georgia and Alabama, may belong to the Triassic series and indicate the former extension of this formation southward; the dip of the beds in New Jersey and the Connecticut valley also attracted his attention and suggested the former connection of these two areas.

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NOTES ON STONE IMPLEMENTS FOUND IN NEW JERSEY.

BY CHAS. C. ABBOTT, M.D.

THE recent article by Prof. Perkins in the January NATURALIST[1] suggests the propriety of my making a brief reference to certain forms of stone implements which have been found in New Jersey since the date of the publication of the Smithsonian Annual Report for 1875;[2] and particularly to the occurrence of such

[1] Archæology of the Champlain valley. By Prof. Geo. H. Perkins.

[2] January, 1877. It may be well to state that the MSS. of my paper was completed in Dec., 1873, and during the six years ensuing, I have gathered fully twelve thousand additional specimens. None of these are referred to in the Smithsonian Report for 1875.

as are identical with those found in Vermont, and which are supposed to be of other than " Red-skin " origin. Prominent among these are the stone tubes. The best New Jersey examples are those from near Bridgeport, Gloucester county, N. J. They are made of a drab-colored clay slate, about one inch in exterior diameter, and ten inches in length. The finish in all respects is excellent, and in every feature are they identical with those described by Prof. Perkins. These New Jersey specimens are in the cabinet of Mr. Wm. S. Vaux, of Philadelphia. Smaller examples of variegated green slate, and others of baked clay[1] have been found by the writer, but none so long or so elaborately wrought as the Bridgeport specimens referred to. Excepting such as have the perforation of very small diameter, these tubes do not differ materially from the California tubular smoking pipes.[2] Curiously enough, associated with these Bridgeport implements were found some magnificently wrought chalcedony spear-heads, remarkably similar to California specimens found in the same graves as the tubular pipes referred to. (See Plate II of Archæology of Wheeler's Survey, Vol. VII.) Interesting as the occurrence of supposed relics of the Mound-builders in Vermont certainly is, it is of greater wonderment that the California types should occur as far distant as the Atlantic coast; unless indeed there is or was a very close connection between the several peoples of the continent. This, it seems to the writer, is highly improbable. So far as the New Jersey examples of stone implements and ornaments of extra-limital forms are concerned, the writer is disposed to refer them to the Shawnees, who at one time occupied much of the valley of the Delaware, and coming from the south-west either brought them from the neighborhoods of their distant homes, the products of their own handiwork, or were at that time even, veritable relics of a forgotten people. Whether the Shawnees were mound builders or not, need not here be discussed. Sufficient to know that they may be located wherever one finds the mounds, and so it would not be strange that they should copy and also preserve the relics of this supposed " pre-Indian " people.

[1] *Nature*, Vol. XIV, p. 154, Figs. 3, 4 and 5.

[2] U. S. Geog. Survey west 100th meridian: Vol. VII, Archæology, plates VII, VIII, IX. The sixteen smoking pipes here figured are not cylindrical like the Vermont and New Jersey examples, but are so far similar as to suggest identical purposes. One tube of uniform caliber I have figured and referred to as a " medicine tube," in another chapter. See the volume.

Prof. Perkins refers to the comparative rarity of grooved axes in the Champlain valley. So far as I can ascertain, they are not plentiful anywhere throughout New England, while in New Jersey and southward they are exceedingly abundant. During the years 1878 and 1879, I gathered nearly two hundred, and have certainly seen at least one thousand in the various private collections I have studied. So numerous are these stone axes in New Jersey, that I think it within bounds to estimate one to every five hundred acres of the State's territory, as ten thousand of these implements are still lying in the ground, and probably half as many more have been already found, and are now in part preserved in public and private collections. As with arrow-points, axes are of every conceivable pattern, and, as yet, no form has been found elsewhere, to the writer's knowledge, that is not represented in New Jersey by one or more specimens. Even the South American form, wherein the groove is reduced to a deep[1] notch on the upper and lower margins, is represented by two specimens found by the writer, and now in the Peabody Museum, Cambridge, Mass.

The remarkable gouge-like implements, on the other hand, are as common to New England as are the axes with us. So dissimilar, however, are the two forms, that it can scarcely be said that the one implement replaces the other. Certainly they could not have had similar uses.

In one respect, the stone implements of Vermont may be said to be superior to those found in New Jersey. This is in the finish and fashioning of the pestles. Pestles with carved heads or any ornamentation are rarely, if ever, found with us. There utility seems to have been wholly aimed at, and, except that some are highly polished, these implements have but little to attract attention. Prof. Perkins refers to the similarity of the Vermont arrow-heads to those of the Southern States, and to a want of likeness to those found in New Jersey. The arrow-heads found here must by no means be judged by those I have figured in the Smithsonian Report. Since the issue of that volume, thousands of more delicate workmanship, and a score of other shapes have been gathered; and I hope ere long to give figures of all these, and also of every pattern of stone implement, ornament or weapon found within the limits of the State.

[1] Archivos do Mus. Nacion. do Rio de Janeiro, Vol. 1, Estampa 1, Fig. 2. Rio, 1876.

SOME NOTEWORTHY BIRDS.

BY SAMUEL LOCKWOOD, PH.D.

THAT was a memorable event in the annals of bird lore when those Arctic owls made their remarkable raid upon us in our centennial year. What it was that induced *Nyctea nivea* to make that visit in such numbers after the big show was closed, and the world's folk had left, may be a question. Probably the commissariat was under consideration; in which case our snowy owl had grave reasons for his coming. Winter is hardly a prime season for delicacies in the larval line, and the construction may seem awkward, yet it will bear assertion that these birds of Pallas were after grub. Though bold, Nyctea did not put on style. It was simply that sort of personal bearing which comes of innocence. In the Northern cities he even perched on chimney tops, and in rural places was familiar with men, even unto rashness. Our farmer friend, his family filling the large carry-all wagon, was on his way to church, when lo! by the road side, "a sitting on a rail," was one of these Arctic owls. No man is himself at all times, and our good friend's piety was sorely tried, for the strange bird actually ogled at him with its big brass-button eyes. He would have railed at the bird. He was on the fence what to do. It is Sunday. Shall he send Thomas back for the gun? The wife suggests they'll be late to meetin'. The bird owes his life to that good woman. In the markets of New York these owls were suspended in strings like poultry. Upon inquiry, Terence was told that they were Spanish geese. "Sure then, for a goose, it has an uncommon knowing face." To many a village "bird-stuffer" in the Eastern States, that winter of '76 brought a large increase of business. In not a few parlors of my acquaintance, a snowy owl became a fixture, and was pointed to as an avian prize. But our splendid bird has become unable to uphold its reputation. The tidy housewife charges it with bringing in that tiny reprobate, the clothes moth, *Tinea flavifrontella*, it of the yellow face, which after plucking Nivea in spots, finishes on the rep upholstery. A young friend captured one of these Arctic raiders alive. So long as he was well supplied with mice, the bird was quite good natured, and even submitted to the caresses of his master; but the young man found the demands of that hungry maw very exacting; in fact that owlish stomach was too

capacious for him to fill, so he killed the bird in order to have it stuffed.

The winter of 1877 brought to the coast of New Jersey an unusual number of the Arctic dovekies, *Mergulus alle*. I was much interested with these queer but amiable little fellows. I held the idea that in their high northern range, they even visit the Pole, thus putting to blush our efforts in that direction. A boy on his way to school saw a bird acting very strangely by the side of a small stream. It was six miles from the sea, and entirely beyond tidal reach. The boy captured it, a simple matter, as he had only to go and pick it up. He took it to school, where the heat and dryness occasioned it much suffering, while its odd appearance and singular action caused much amusement. It stood so bolt upright that the scholars said the bird stood on its tail. When the lad got home a tub of water was procured, and then came the fun. The bird seemed crazed with delight. It ducked and dove and splashed. Then it would make a dash, fetching up against the side of the tub in a manner not altogether "healthy;" but then Mergulus is not the only biped that takes a winter tub in an injudicious way. I had furnished the local editor a paragraph in which was given the systematic name of the bird. Another specimen was found in a neighboring village, standing on the wood-pile in the back yard of a house, also some distance from salt water. It was mounted by the local taxidermist, who ambitiously named it from the newspaper paragraph. It found its way to the bar-room of the tavern, where I saw it, and was told its name by the obliging landlord, who said that he got it from the bird-stuffer, who told him that it was scientific. "Ah, indeed! Could you tell me what it means?" "Oh, yes! Our doctor says *Mergulus alle* means all-sea-gull." It would have been neither courtesy nor policy for me to say that mine host and the doctor were gulls all over.

I am at a loss to conceive why these birds, so thoroughly marine in their nature, come so far inland. Flight must be very laborious to them, and every motion on the land is awkward to a degree. But in the water, all is truly wonderful—there the bird displays grace, speed and a certain refinement of motion. There is much to wonder at and to admire in the sea dove's ways when in her own element. Just stand with us on the bluff at Long Branch. There is a high swell, for the wind is pretty stiff and

directly from the sea. We shiver in this wintry gale. How crushingly the surf comes rolling up the strand. What grand high waves they are—and to what a solemn cadence is the whole movement made. There are several sea doves, to whom all this is blissful and delicious. When it suits they can ride the crest like the stormy petrel. But see that gorgeous wave approaching, and that sea dove goes right through it, as an arrow shot through a cloud of smoke; and the bird comes out into the deep trough beyond, and with every feather dry. And now it scoons along the green glassy bed of that aqueous valley, then up the round side of that great water mountain which it has just pierced, then it sits like a little puff on the advancing crest. These are the nice points in the high art of natatory locomotion. It can float like a bubble and progress like a shot, while its rapid sub-aqueous movement, as against the momentum of the incoming wave, calls out one's admiration. And what about the molecular thrill of that tiny avian brain? You may depend there is high glee there. Forward it comes, borne on that great surf-wave, which now strikes the shingly beach and breaks up into wild seething froth. The little bird, like a dark spot, ascends the sloping shore so quietly riding on the mad, white foam. Its grand role, however, is over. It suffers itself to be left high up on the beach by the scattered, receding surf. The shore seems alive with sand fleas, and *Orchestia agilis* is a dainty shrimp-like bait for our sea dove. The bird appreciates the opportunity, and sets itself to make the most of it. But oh, how awkward! But then, how is a body to put one's best foot forward when both *pes* are set so extremely far backward? So its every effort to capture Orchestia on dry land is decidedly inartistic. As if to save it from damaging so fine a record, my pupil's shaggy white retriever walks quietly up to the bird, takes it in his mouth, and carries it to his master. "Ah, Whitie! you have nipped birdie a little too hard, and Dovekie has come to grief."

In November, 1878, my friend the railroad conductor called on me. He had with him a box obtained at the grocery, which, with laths nailed on one side, he had improvised into a bird cage. The cage was carried by a boy whom he ordered to set it on my study floor, which done he thus made known his errand:

"Professor, here's a queer bird which we caught on the beach at Manasquan. I went up to it, and w it did not

fly away. Nobody knows what it is, neither the fishermen nor the old gunners along the coast. They all say that it is a tropical bird, and the most of us think it has been a pet on some vessel inward bound, and that it somehow got overboard and had to work its way to land. So I have come to see if you can tell us what it is. Now then, Pet, come out and show yourself to the gentleman." Having thus delivered himself with the same preciseness as when calling out the stations for his passengers, the conductor pulled up a few of the slats, and sure enough, the pet did come out and show himself. He had a body about as big as a pigeon's, with long legs and long toes. I had never seen his like. But there were certain features so noticeable, that with "Coues' Key to North American Birds," the merest tyro could soon determine the genealogy of the stranger. The bill was pinkish-red, and as Patrick might have remarked—"The cratur carried a breast-plate on the front of his head; and though with never a stocking to its name, it wore red garters on its legs." The bird had on its forehead a flat smooth plate like red coral, or sealing-wax, giving it a somewhat cooty aspect; and around each tibia was a red band, as if a fillet of the outer skin had been removed. It was the Florida Gallinule, *Gallinula galeata.* There was no strut in its walk. But for the occasional slipping of those great splay feet on the smooth oil cloth, the bird sustained a self-possession, with a dignity of carriage which was charming to witness. I called in my family to see the interesting stranger. Their entrance in no wise disconcerted Gallinule, although Madam stroked him on the back and patted him on his head, and even felt of his helmet plate. He was evidently a person not to be injured by flattery. Although undesigned, there seemed to me genuine humor in the contrast of the running down of an insect on the lily pads of a Florida pond and that stately megalopodian tread on my study floor. But for our confiding nature we should have suspected the stranger of putting on uprightness, an instance of mimicry of that good old knight, Sir John Auricular, who in all God's ways walked perpendicular. I came near asking, "Where did the bird get so much good breeding?" but was interrupted by the conductor, who reiterated his theory as sufficient for the facts: "You see, Professor, how tame he is, and gentle. He doesn't mind anybody. It's that which makes us believe he is a pet off some ship." "I don't think so; though for all that

it is barely possible that he may have been on a ship; for he has a gay cousin down south, the purple Gallinule *(Porphyrio martinica)*, who has been known to board a vessel two or three hundred miles out at sea." We set to work to search the house for flies, the whole family going at it with zest. Here again the bird awoke our interest. With no flurry, but in a quiet and most sensible manner, he would approach the person bringing a fly, and take it gently, in such a knowing way, from between the thumb and finger. I was much impressed with the belief that scent had much to do with the matter, as the insect was so held that it could not be seen.

Again the conductor suggested his theory to explain the fact: "You may depend, Professor, he's a tame bird, and is used to being fed from the hand." We had a theory, too, but which we did not broach, to wit: that it was a specimen of extra good bird sense, actuated by the keen demands of appetite. But it was so late in the fall that the flies were quite scarce, and we could not find one more. We then tendered him cake and bread crumbs, to which he took very gingerly, evidently not hankering after such rations. Some fresh water was set before him, of which he took a pretty good drink; after this, entirely of his own option and in a very quiet way, he went to his cage, entered, and squatted on its floor, and in its own dumb way seemed to say to its owner, "Please, sir, now shut the door." Bidding the boy who was with him to carry the box, the conductor and his singular pet left. Thus cooped up, with not a vestige of its natural environment, either as to food or water, in two days the poor bird died. I saw it not long after, a mounted specimen in the bird-stuffer's shop. But now the red garters had faded into a foxy hue. So too had the rosy bill. As for that quaint frontlet of polished red coral, it had lost both color and form, for it had shriveled up into an unsightly rosiny scar.

Such are a few memory notes of life features on the human side, of some of our rare New Jersey birds.

ON THE MICROSCOPIC CRYSTALS CONTAINED IN PLANTS.

BY W. K. HIGLEY.

IT has been the custom to call all crystals that occur in plants, whether in the cell contents, the cell-wall or even the non-microscopic crystals that are found in the outer portions of plants, by the common name "raphides," no matter what the form may be. And while giving this general name to their form, a much more general chemical composition was given, viz: oxalate of lime; and for a long time they were all supposed to have had this composition, and even up to the present day many writers have considered them thus. The decision of some seems to have been based on the analysis of the inorganic matter of one crystal-bearing plant, which proved to have the above composition, and in drawing their conclusions they considered that all crystals of apparently the same crystalline form, were of the same composition. But it is difficult to tell, at all times, the exact crystalline form, as different forms sometimes resemble each other very much. And as the form may vary, so may the chemical composition. Crystals of some form seem to be nearly or quite universal; on close examination they may be found in some part or parts of the majority of plants. In some plants they are only found in a certain position and of one form, while in others they may occupy several localities of the plant, and have as many forms. But the position and form often vary so much that it has been recommended by some authorities that they be made a family, and in some cases a generic distinction in the study of systematic botany.

Prof. Geo. Gulliver, while making dissections under the microscope for the purpose of comparing the relations between the structure of plants and animals, made note of every case, in the examination of plants where raphides or other crystals occurred, and he says: "It was not before a large accumulation of my notes had been examined that crystals were thought of in this point of view; for they had not even been particularly looked after, and were merely noted whenever seen, long before their significance as characters were suspected. But when every one of these notes on raphides had been picked out, it was very unexpectedly discovered that the plants in which they occurred would sometimes come under certain orderly arrangements.

Thus not a single species belonging to the order Onagraceæ or Galiaceæ was without a note of raphides, while in no single instance were these acicular crystals noted in the next allied orders." A converse example is then given. He then proves by more extended experiments that raphis-bearing is essential throughout the lives of certain species. By this and other experiments that I might mention, it is shown that the form and position of microscopical crystals in plants may be used as a distinctive character between orders especially, and perhaps to a certain extent, between genera and species (?). Plant crystals as a character would only be of benefit to the botanist who had at hand a microscope that magnified at least a hundred and twenty-five diameters. Hence the objection to making them a means of identifying plants in our works on systematic botany.

As to the history of crystals, Lindley states that they were first seen by Rafn, who found them in the milky juice of some species of the family Euphorbiaceæ, and that they were afterwards seen by Jurine in the leaves of *Leucoium vernum* and elsewhere.

Edwin Lankester, M.D., writing on raphides, credits Malpighi with the discovery of crystals in plants, who found them in a species of Opuntia, and he says, further, that they were afterwards described by Rafn as occurring in the milky juice (latex) of some plants belonging to the family Euphorbiacæ, and that Jurine soon after found them in the leaves of *Leucoium vernum* as stated by Lindley.

Raspail seems to have been the first person who studied crystals with their chemistry in view, at least he was probably the first to demonstrate that some of the crystals were composed of calcic oxalate.

John Quekett, in a paper written in or about the year 1852, also gives the credit of the discovery to Malpighi, and says that they were subsequently described by Jurine and Raspail, as stated above.

Prof. Gulliver says that the raphides so early mentioned by Rafn in the Euphorbiaceæ were only the starch-rods which he (Gulliver) described as having found in the latex of the British Spurges.

Crystals should be divided into (at least) three classes and these seem to cover all the ground that was formerly covered by the name "Raphides." They are as follows:

1. Raphides.
2. Sphæraphides.
3. Crystal prisms.

1. *Raphides.*—The term raphid is from the Greek ῥαφίς, a needle. and was formerly applied by De Candolle to crystals resembling a needle in form.

Prof. Gulliver gives the following definition of the term: "These are slender needle-like crystals with rounded, smooth shafts, vanishing at each end to a point, from about ten to fifty or more lying parallel together so as to form a bundle, which partially fills a cell or intercellular space."

I have never been able to find over thirty in one cell, and generally from five to twenty-five. The cells which contain them are generally elongate, or quite oval. To obtain these crystals in a bundle and still have a thin section fit for microscopical work, a steady hand and great care are required, as they are easily disturbed, when they will be seen scattered in every direction. Often on slight pressure they are seen to escape, one by one, quickly from one or both ends of the cell. When this occurs they are then known as "Biforines." The bundle of crystals is very loose and might be compared to a bundle of needles.

The genus *Trillium* affords a good example for the investigation of these crystals, and still better the species of the family *Araceæ*, with one exception which will be mentioned soon. In this family the raphides are found in great abundance and are about the largest that I have seen. As the plants of this order are very common, any one may examine them at pleasure. They may be found in any part but are best seen in the stem.

2. *Sphæraphides.*—This word is from the Greek σφαῖρα, a sphere or globe, and ῥαφίς, a needle or pin. "They are more or less rounded forms made up of a congeries of crystals, many of which are prisms, often acicular." As they often have points extending in all directions from the main body of the crystal, they appear rough and frequently stellate; they are generally found regularly placed, one imbedded in the substance of each cell. A collection of cells containing these crystals is known as a "sphæraphid tissue."

The flower parts of the geranium serve as a good field for observing them. These crystals are very common and are found in connection with raphides in the family Vitaceæ. But the best place to examine them is in the family Cactaceæ. These crystals as well as the next class were formerly known, incorrectly, under the common name "Raphides."

3. *Crystal prisms.*—These are "acicular forms with well-marked faces and angles both on the shafts and tips." They are found imbedded in the tissue of the plant and are never seen in bundles or loosely packed together, or single in a cell or intercellular passage. I have found as many as five of these crystals imbedded close together in certain tissues, but generally only one. They vary much in size but are generally much larger than raphides from which they may be easily distinguished. The family Compositæ furnish about the best field for the examination of this class of crystals, but they are much less common than the other forms of crystals.

My own observations and experiments have been, at present, mostly confined to the natural orders Araceæ, Vitaceæ and Compositæ. I examined the first two orders especially, as they abounded in crystals, and this gave me a better opportunity to examine into their chemical composition with more sure and satisfactory results.

In examining each specimen for the composition of the crystals, I first made the test under the microscope as far as possible, and in the case of inorganic crystals incinerated the substance and analyzed the residue. Of course from this analysis it is not possible to state the exact composition of the crystals, whether they are, for example, acid or neutral salts; but we are able to state with certainty what the elements are that enter into the crystal. And at times and under certain conditions, and also by analogy, the exact composition may be ascertained; for example, if on examining the tissues of a plant octahedrons are found, and if under the microscope they do not effervesce with acetic acid, but do with stronger acids, and if after incineration we find on analysis calcium and carbonic acid, we may conclude with certainty that these crystals are composed of calcic oxalate. However, other acids than the one just mentioned do occur, as phosphoric and carbonic acids; the former I tested for under the microscope in the following manner: obtaining as large a field as possible of the crystals, I added a drop of hydrochloric acid and heated the slide slightly and then added a small amount of molybdate of ammonia; heating the slide again and allowing it to stand for some time, I placed it under the microscope, when, if any phosphoric acid was present the characteristic crystals of phospho-molybdate of ammonia would appear. These crystals

are stellate forms consisting of four or six points, and have a yellow color. *This test requires care, as too much heat seems to dispel the crystals.*

The latter (carbonic) acid I detected in the usual manner with acetic acid.

The three acids mentioned above are the only ones that I found. Dr. Gray, in his " Structural and Physiological Botany," page 60, reports sulphuric acid.

The tests applied for the base were the same as those given in Douglas and Prescott's " Qualitative Analysis," but the only base found was calcium. The methods of testing given above were followed in nearly all cases. Where there is any change it will be mentioned in its proper place.

I will now give the results of my own work, commencing with the order Araceæ; in this order the raphides are abundant and large, and the cells that contain them are much elongated. The bundles contained from ten to twenty-eight crystals. The number was noted in twenty specimens and the average, twenty-five, taken from the results. Raphides were found in all parts of the plant *Arisæma triphyllum*; they varied some in size, but were, on the average, about $\frac{1}{100}$th of an inch long and $\frac{1}{10000}$th in diameter. The raphis-cells were very large and elongated and easily distinguished from the surrounding cells.

Dracontium, another species of the same genus as the above, showed no material difference in the position, size and number of the crystals from the first species.

In *Symplocarpus fœtidus*, or skunk's cabbage, the crystals were as common as in Arisæma, but were, on the whole, somewhat larger, and were found, as in the above species, throughout the plant. The raphis-cells of this plant were about $\frac{1}{80}$th of an inch in length and $\frac{1}{1000}$th in diameter. Some of the crystals appeared to be biforines, which I did not observe to be the case in any other species of this order. Thus if the odor of this plant can be overcome, it furnishes a good field for work upon this subject.

In *Acorus calamus*, or sweet flag, I was not able to find a single raphid, and as far as I am able to find articles upon the crystals of this family, none have ever been reported, but time and again students have been disappointed in not finding them. This genus is thus marked off from the rest of this family, although agreeing with the family characters perfectly in other particulars. Dr.

Gray, in his systematic arrangement of plants, places this genus in the family Araceæ, but Lindley, on account of there being no raphides, and as the general characters of the plant would not permit of its being placed in any other family, places it in a family by itself, calling it Acoraceæ. This genus contains but few crystals of any sort. On examining a number of specimens I found only a few crystal prisms, which effervesced and dissolved with hydrochloric acid and were probably oxalate of lime. With the exception of the genus Acorus the crystals mentioned in this family showed with certainty that they were composed of phosphate of lime when the chemical tests were applied both under the microscope and also to the incinerated residue.

[*To be continued.*]

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The late meeting of the American Association for the Advancement of Science at Boston, under the presidency of the Hon. L. H. Morgan, was a very successful one. There was a large attendance, most sections of the United States and Canada being represented. A considerable number of papers of a high order of merit were read. Propositions for a precise and convenient division of the work of the Association were considered, and a report on the subject may be expected at the next meeting.

The arrangements made by the local committee were excellent, and the most convivial member could not complain of any deficiency of receptions or "lunches," either as to quantity or quality. The excursion to the White mountains was replete with interest to the geologist, the more so as it was accompanied by the State Geologist of New Hampshire, Prof. Hitchcock.

Of the addresses of the officers, we refer to two as especially interesting to our readers, viz: those of Prof. Barker, the retiring president, and of Mr. Agassiz, vice-president in charge of Section B. The former was a general exposition of the present state of knowledge of the physics of life. The chemical nature of the respiratory and digestive functions, and the dynamic characteristics of muscular contraction were passed in review. The character of nervous telegraphy was discussed, and its relations to mental phenomena considered. The conversion of force in reference

to these acts was set forth in the light of recent investigations, especially those conducted by the aid of the plethysmograph. The identity of conduct of vegetable and animal protoplasm under stimuli and reagents, was regarded as warranting the conclusion that the properties of animal protoplasm have a previous existence in the plant, and that the solution of the vital question in the lowest fungus will solve the problem for the highest vertebrate.

The address then considers the relations of the forces displayed by living bodies to those exhibited by the space-filling ether. In accordance with late usage he discards the term potential energy. and regards the energy of the supposed molecular movements of the ether as representing what was originally intended by that expression. He closes by remarking, "Is it a wonder that out of such a reservoir, the power by which we live should irresistibly rush into the organism and appear as the transmuted energy which we recognize in the phenomena of life?" Further than this speculation can not go, but such language is useful if only as an indication that the field of vital phenomena is not necessarily restricted to our planet or even to our system.[1]

We note here that Prof. Barker has not touched on the question of consciousness in his address, and it might be supposed that he does not regard it as an essential element in the problem. This omission may be explained on the supposition that he does not know what to do with it; for it certainly does not seem to have any appropriate niche in the system of the purely physico-vitalists. For our own part we cannot escape it in considering the evolution of forms; that is as modifying growth nutrition, through molar movements.

Mr. Agassiz's address is an exposition of the palæontological and embryonic histories of the *Echini*, with a discussion of their bearing on the question of evolution. He refers to the early labors of Profs. Agassiz and Vogt on the palæontology and embryology of fishes as the starting point of discussion of the doctrine of parallelism. After a thorough review of the facts, Mr. Agassiz finds the history of the *Echini* to present a conformity to the general law, and that it exhibits, moreover, certain peculiarities. The rule is, that each character taken separately presents an "exact parallelism" between its palæontological and its embryonic histories, but the characters taken collectively, in the combinations which constitute species, do not present such a parallel. In other words, that no extinct species, taken as a whole, is identical with a transitional stage of any recent species. He says, "Any attempt to take up a combination of characters, or a system of combinations, is sure to lead us to indefinite problems far beyond our power to grasp." Here we see the author wrest-

[1] See *Penn Monthly*, 1875, p. 574. AMERICAN NATURALIST, 1879, 420, and 1880, p. 269.

ling with the universal phenomenon of "inexact parallelism," which has received satisfactory explanations at various times.[1]

It is gratifying to find Mr. Agassiz giving a general assent to the doctrine of derivation, but we observe that he cannot forbear intimating that he does not enter the ranks of the evolutionists on account of the society he finds there. He says in effect,—your derivation is probably true, but you can't tell how it was done, so what are you going to do about it? And he proceeds to show that they cannot do anything about it, in the following manner: "The time for genealogical trees has passed; its futility can, perhaps, best be shown by a simple calculation which will point out at a glance what these scientific arboriculturists are attempting. Let us take for instance the ten most characteristic features of the *Echini*. The number of possible combinations which can be produced from them is so great that it would take no less than twenty years, at the rate of one new combination a minute for ten hours a day to pass them in review. * * On the other hand, in spite of the millions of possible combinations which these ten characters may assume when affecting not simply a single combination, but all the combinations which might arise from their extending over several hundred species, we yet find that the combinations which actually exist—those which leave their traces as fossils—fall immensely short of the possible number. We have not more than twenty-three hundred species actually representing for the *Echini* the results of these endless combinations. Is it astonishing therefore that we should fail to discover the sequence of the genera, even if the genera, as is so often the case, represent, as it were, fixed embryonic stages of some sea-urchin of the present day?"

Precisely what relation the above considerations bear to the tracing of the phylogenies, it is difficult to perceive. If Mr. Agassiz had insisted that any or all of the millions of possible combinations he has pictured may have existed as extinct species, he would indeed have presented us with an inextricable genealogical puzzle. But he does not do this, for he admits that the number of the forms which have actually existed is limited. Does Mr. Agassiz mean that there has been no order in this limitation; that there have existed no causes which have rendered some combinations possible and others impossible? Such would appear to be the spirit of his proposition, but it is the objection of a mathematician, and not that of a practical biologist. The chairman of Section B admits that genealogies of single characters may be constructed; therefore genealogies of orders, families and genera can be constructed, for they are, or ought to be (for they ultimately must be), defined by single characters. Having thus established the lines of primary definition, the possible range of variation of the contents of the divisions so defined, is greatly restricted. We can no more anticipate the combination of the characters of two main

[1] See Origin of Genera, 1869, pp. 34-35.

lines of *Echini* after they have been differentiated, than we can expect to find fossil centaurs or sphinxes. So also with the minor lines, though of course the sagacity of the investigator is taxed to ascertain what these are. Thus much in defence of hypothetical lines bridging present gaps in our knowledge. Such have not unfrequently been realized by palæontological discoveries. As to lines already worked out, such as the genera of *Camelidæ*, *Felidæ*, *Rhinocerontidæ*, horses, etc., no question of mathematical probabilities can invalidate the significance of the wonderful closeness of the successive stages which they present.—*E. D. C.*

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RECENT LITERATURE.

NELL'S NEW MAP OF COLORADO.[1]—It is strange that in this country there are no map-makers worthy the name. The only decent maps, either of the whole or portions of the country, are those published by the General Government.

It is sad, but true, that the best map of the United States which can be purchased, and I may add which can be obtained, is published not here but in Germany. This is not from want of skill in drafting and engraving, but it seems to be a want of knowledge, of enterprise and of care in those superintending the work. I am roused to this philippic by the appearance of a map of Colorado, which is a vast improvement, both in style and in correctness of compilation, over anything heretofore published for sale in this country.

The map has been compiled by Mr. Louis Nell, a topographical engineer who has been for a number of years connected with the Survey of the Territories under Capt. G M. Wheeler. He has brought to the work not only a general knowledge of how a country should be represented on a map, but a personal acquaintanceship with a large part of the country represented. The map shows, too, a degree of painstaking accuracy and care which is very rare among us.

The map is evidently compiled, although authorities are not mentioned in detail, from the work of the surveys under Hayden, Wheeler, King and the General Land Office. The scale of the map is 10.5 miles to one inch. The topography is represented by hachures and by contour-curves at every 1000 feet up to 11,000 feet. The county lines are given, and it may be said, in passing, that the map might have been a little clearer if these lines were less pronounced.

All the later changes due to settlement, roads, railroads, etc., have been added, bringing it fully up to date. The estimated area of irrigable (arable) land is represented by colors. The ele-

[1] *Nell's New Topographical and Township Map of the State of Colorado.* Compiled from U. S. Government Surveys and other authorities. Washington, D. C., 1880. Scale 10.5 miles to one inch.

vations of many hundreds of points are given in feet above sea level, and to illustrate the careful nature of the work, it may be noted that those measured by spirit-level are distinguished from those dependent upon the barometer.

It is to be hoped, in the interest of map-making in this country, that Mr. Nell may see his way clear to extending his work and making this one of a series.—*H. Gannett.*

HAECKEL'S SYSTEM OF MEDUSÆ.[1]—The early reputation of Haeckel rested mainly on his great work on the Radiolaria, a magnificent and costly folio volume with numerous beautifully executed plates; this was succeeded by his smaller works on the Monera and other invertebrate animals; his great work on sponges then succeeded; in the embryological portion of this work some errors have naturally been detected by subsequent observers. Then Haeckel prepared his popular, more general works, *i. e.*, the General Morphology, his History of Creation and Anthropology. In these works he gave rein to his imagination, and while he attempted to solve problems insoluble in our day and with our present knowledge, and though opening up new lines of investigation, yet committed some extravagances of scientific thought, and in some statements, and especially illustrations from his prolific pencil, overstrained or actually misrepresented nature to suit his own generalizations or ideas. This laid him open to criticism, especially from other observers of eminence, those whom Haeckel had mercilessly and at times coarsely vituperated for what seemed to him blunders and shortcomings, though the charges he made against others have recoiled upon himself. It has been of late a current remark, that Haeckel has lost prestige and that his work upon the whole is not to be depended upon. Hence the scientific public are perhaps taken by surprise at the energy, strength of purpose, industry, accuracy and great skill in delineation shown in the work before us, a work analytical in intention, thoroughly systematic, and which is said by those most competent by long acquaintance with the jelly fishes to judge, to be quite up to the best of Haeckel's systematic and anatomical work. We confess we have a hearty sympathy for those pioneers in biology who, in endeavoring to open up new paths of research, are not afraid to work at times in the dark, and indulge in what prove in some cases to be hasty generalizations, or far-fetched conclusions from too scanty facts. We all forget that Newton emitted several theories which were short lived, and that the best of observers and thinkers sometimes do what proves later to be rash, useless or actually misleading work.

The part before us describes the Craspedote, or naked-eyed

[1] *Das System der Medusen. Erster theil einer Monographie der Medusen.* Von Dr. ERNST HAECKEL. Mit einem Atlas m. 40 plates. Erste hälfte des ersten Theils. System der Craspedoten. 20 Tafeln. Jena, 1879, folio. (Denkschriften der Med. Naturwissenschaftlichen Gesellschaft zu Jena.) Pages 360.

Medusæ, the first legion of the class Medusa. There is no preface or introduction, but the descriptive part opens with a systematic register of the orders, families, genera and species of the legion; then are given the synonymy and characters of the Craspedotæ, of the two sub-legions into which they are divided, then of the orders and minor subdivisions, the definitions being detailed with explanatory remarks. The synonymy and descriptions of the species are fully given, so that the whole is a comprehensive monograph of the naked-eyed Medusæ of the globe; an ambitious undertaking, but one apparently well carried out.

The work is richly illustrated, the large plates being crowded with elegantly drawn figures; they are not so delicate as the illustrations of the Radiolaria, being chromo-lithographs, but are calculated to give some idea of the richness of tints of these beautiful and delicate marine forms; the illustrations are all drawn by the author, and the anatomical details are full and elaborately presented.

The author is anxious to receive specimens of jelly fishes from the Pacific coast for description in the remaining parts of this work, and those who are favorably situated should by all means contribute to the material which will be so well used. From the excellent figures of alcoholic specimens in this work, it is evident that specimens can be preserved and transmitted great distances in spirits.

Recent Books and Pamphlets.—A sketch of the history of the fossil Vertebrata of India. By R. Lydekker. 8vo, pp. 36, 1880. From the author.

List of the members of the American Philosophical Society. 8vo, pp. 72, 1880. From the society,

Proceedings of the American Philosophical Society. 8vo, 1880, pp. 511–598.

Notes on the Geology of the Iron and Copper Districts of Lake Superior. By M. E. Wadsworth. (Bull. Mus. Comp. Zoöl., Geol. Ser., Vol. 1.) 8vo, pp. 157, pls. 6, 1880. From the author.

Descriptions of new species of North American Fishes. By David S. Jordan. (From Proc. U. S. Nat. Mus.) 8vo, pp. 9, 1880.

Description of a new species of Sebastichthys (*Sebastichthys miniatus*) from Monterey bay, California. By D. S. Jordan and C. H. Gilbert. 8vo, pp. 6, 1880.

On the Generic Relations of *Platyrhina exasperata*. By D. S. Jordan and C. H. Gilbert. 8vo, pp. 1, 1880.

Notes on a collection of Fishes from San Diego, Cal. By D. S. Jordan and C. H. Gilbert. 8vo, pp. 12.

Description of a new Flounder (*Xystreurys liolepis*) from Santa Catilina island, Cal. By D. S. Jordan and C. H. Gilbert. 8vo, pp. 16, 1880.

Notes on Sharks from the Coast of California. By D. S. Jordan and C. H. Gilbert. 8vo, pp. 1, 1880.

Description of a new species of Ray (*Raia stellulata*) from Monterey, Cal. By D. S. Jordan and C. H. Gilbert. 8vo, pp. 7, 1880.

Description of a new Agonoid Fish (*Brachyopsis xyosternus*) from Monterey bay, Cal. By D. S. Jordan and C. H. Gilbert. 8vo, pp. 6, 1880. From the authors.

Remarks on the species of the genus Chirus found in San Francisco market, including one hitherto undescribed. By W. N. Lockington. 8vo, pp. 5, 1880.

Description of a new Fish from Alaska (*Uranidea microstoma*). By W. N. Lockington. 8vo, pp. 2, 1880.

Description of a new species of Agonidæ (*Brachyopsis verrucosus*), from the coast of California. By W. N. Lockington. 8vo, pp. 9, 1880. From the author.

Observations on Mount Etna. By S. P. Langley. (From the Amer. Jour. Sci. and Arts, Vol. XIX, July 1880.) 8vo, pp. 12, 1880. From the author.

Introduction to the Study of Mortuary Customs among the North American Indians. By Dr. H. C. Yarrow. 4to, pp. 6, 114, 1880. From the author.

Contributions to the Archæology of Missouri. By the Archæological Section of the St. Louis Academy of Science. Pt. I.—Pottery. 4to, pp. 30, maps 5, pl. 24, 1880.

Memoirs of the Geological Survey of India. Series X. Indian Tertiary and Post-Tertiary Vertebrata. Vol. I, pt. IV.—Supplement to Crania of Ruminants, pp. 172–181, pl. 21–24. Pt. V.—Suvalik and Marbada Proboscidia, pp. 182–300, pls. 29–45. By R. Lydekker. From the author.

The Valley Naturalist. Vol. ii, No. 1, 8vo. St. Louis, 1880. From the editor.

The Student. Vol. 1, No. 1, 8vo, 1880. From the editors.

Palæontographica. Breiträge zur Naturgeschichte der Vorzeit. 4to, pp. 88, pl. 11. Cassel, 1880. From the editors.

Beiträge zur Kenntniss der Flussfische Südamerika's. Von Dr. Franz Steindachner. 4to, pp, 23, pl. 4, 1880. From the author.

Ueber den geologischen Ban der libyschen Wüste. Von. Dr. Carl A. Zittel. 4to, pp. 47, map 1, 1880. From the author.

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GENERAL NOTES.

BOTANY.

The Fertilization of Aquilegia vulgaris.—A note by Mr. Thomas Meehan, in the "Bulletin of the Torrey Club" for June, 1880, recording the perforation of the curved spurs of certain species of columbine, induces the publication of the following article, based chiefly on the observations of Sprengel[1] and Dr. H. Müller.[2]

As the plant commonly grows, the flowers are pendant. The five sepals are petaloid, nearly flat, and aid in rendering the flowers conspicuous. Each petal is somewhat funnel-shaped at its base, but quickly narrows into a slender tube 15–22 mm. in length, which is bent inward and downward at about 5 mm. from its free end, nectar being stored in the portion beyond the bend, where it is secreted by a glandular thickening of the wall.

The pendant position of the flower renders it inconvenient for lepidoptera to obtain the nectar, for if they would do so they must hang from the lower part of the flower, since their proboscides flex readily only in a ventral direction; and this position is not always to their liking. The length of that portion of the spur lying below the bend is a sufficient protection against the removal of nectar by bees with short tongues, and the curvature seems to be a pretty good way of excluding birds, which, as Prof. Todd has shown,[3] and as I have observed during the past spring, visit the flowers of our native *Aquilegia canadensis*. Thus it

[1] Entdeckte Geheimniss, 1793. S. 279.
[2] Befruchtung der Blumen, 1873. S. 118.
[3] Am. Naturalist, Sept., 1880, p. 668.

appears that the nectar of these flowers is perfectly accessible only to insects whose slender and flexible suctorial mouth-parts reach a length of not less than 10 mm.; and these insects must be habituated to hanging upon flowers while probing them for their sweets. These requirements are met with only in certain humble bees. Sprengel records the flowers as being visited for their nectar normally, and fertilized, by large humble bees. Dr. Müller, from observations extending over a number of years, finds two species of Bombus which act in this way; the first, *B. hortorum*, has a tongue reaching a length of from 19–21 mm.; the second, *B. agrorum*, has a tongue varying from 12–15 mm. in length. When collecting nectar, one of these bees hangs upon the flowers with its prothoracic legs on the base of a spur, the mesothoracic and metathoracic limbs clinging to the column formed of the stamens and pistils. Inserting its head as far as possible into the flaring mouth of the nectary, it passes its tongue into the spur, the curve of which is readily followed when the insect occupies this position, in which the ventral surface of its body is brought in contact with the essential organs. But the flowers are proterandrous, the anthers only being mature in young flowers, while they are replaced by the receptive stigmas in older ones; so the bees, going from plant to plant, constantly cross older flowers with pollen from those which are younger, and, from their habit of visiting the lower (and older) flowers of a plant first, they usually cross the flowers of distinct plants. Where the nectar has been removed from flowers, the bees soon learn to probe only a single spur, and finding this empty, seem to reason that it would be a useless waste of time to try the others, and hasten on to another flower. Many years ago Necker proved the value of these nectaries for the fruiting of the flower, for he found that no fruit was set after their removal; but he does not seem to have arrived at the correct explanation of the result of his experiment.[1]

Concerning the perforation of the spurs of the corolla, Sprengel tells us that he found hive bees (? Bienen) on the flowers, which first collected pollen, then betook themselves to the bend in the spurs, which they bit through, thus readily obtaining the nectar. Dr. Müller found two small wild bees—species of Halictus—collecting pollen from the open anthers, but they showed no tendency to obtain nectar, and hive bees trying, failed. He found, however, that an humble bee (*Bombus terrestris*), having a tongue not exceeding 9 mm. in length, and therefore debarred from partaking of the sweets with its more fortunate relatives, seemed to learn by individual experience the futility of attempting to reach the nectar in the normal way, afterwards acquiring the habit of

[1] Acta Academiæ Theodoro Palatinæ, v (*fide* Senebier). Soyer-Willemet also observed the same fact, and advances it on p. 13 of his "Mémoire sur le Nectaire" in support of his theory that nectar played a direct rôle in the act of fecundation.

alighting on the hook of the nectaries and perforating them on the convex side, securing their prize through the opening thus formed.

It is well known that one or more of our sixty-two North American species of Bombus habitually perforate flowers whose nectar is inaccessible to them normally; and from the shortness of the spurs of certain flowers like *Dicentra canadensis* and *D. cucullaria*, which, as every lover of our spring flowers must have noticed repeatedly, are invariably disfigured in this manner in some localities, it is to be inferred that some of these bees have very short tongues, though I am not aware that the species have ever been carefully compared in this respect. The individuals that Mr. Meehan found perforating columbines, in all probability did not possess tongues sufficiently long to enable them to obtain the nectar in the regular way.

While, therefore, *Aquilegia vulgaris* is visited normally to a certain extent by hive bees, small wild bees and short-tongued humble bees, which either in gathering pollen or trying to obtain nectar must, necessarily, aid in the cross-fertilization of the flowers, it seems perfectly adapted to profit by the visits of the long-tongued species of Bombus, and I must therefore depart from the conclusions of Mr. Meehan, that "the humble bee and the honey bee are evidently not the insects for which the Aquilegia had this beautifully contrived nectar cup provided to induce cross-fertilization, and what particular insect was designed to be the favored one, so that it and no other could turn its tongue around these twisted spurs to get at the honey in the end, I think no student has discovered," so far as to believe that the evidence in the case warrants the conclusion that certain species of "the humble bee" *are* evidently the insects for which the Aquilegia had its beautifully contrived nectar cup provided to induce cross-fertilization.—*William Trelease.*

PLANTS OF NOVA SCOTIA, CAPE BRETON AND NEW FOUNDLAND. —The following list of plants represent the results of herborizing in an interesting region:

Thalictrum cornuti L., Torbay, N. F.
Ranunculus hyperboreus Roth., Open Hall, N. F. In black mud.
" *repens* L., Guysborough, N. S.
" *acris* L., Guysborough, N. S.
Sarracenia purpurea L., Arichat, Cape Breton island.
Drosera rotundifolia L., at Arichat, with *S. purpurea* L., and *Calopogon pulchellus* R. Br., in moist moss, and at Open Hall, N. F.
Stellaria media Smith, Guysborough, N. S., Torbay, N. F.
" *longifolia* Muhl., Torbay, N. F.
" *uliginosa* Murr., Torbay, N. F.
Cerastium viscosum L., Torbay, N. F., Guysborough, N. S.
Malva moschata L., Guysborough, N. S. Both the white and the purple-flowered forms common on roadsides.
Oxalis acetosella L., Guysborough, N. S.
Spiræa salicifolia L., Open Hall, N. F.
Poterium canadense L., Cape Broyle, N. F.
Potentilla norvegica L., Carbonier, N. F.

Potentilla tridentata Ait., Arichat, Cape Breton island. **Extremely numerous** the treeless barrens above the village.
Fragaria vesca L. ? Arichat, Cape Breton island.
Rubus triflorus Richards, Arichat, Cape Breton island.
" *villosus* Ait., Torbay, N. F.
Rosa lucida Ehr., Carbonier and Open Hall, N. F.
Cicæa alpina L., Guysborough, N. S. This and *Oxalis acetosella* L., occ enormous numbers over the moist shady hillsides in the vicinity of borough.
Epilobium angustifolium L., Guysborough, N. S., Cape Broyle, N. F.
" *coloratum* Muhl., Torbay, N. F.
Œnothera fruticosa L., Guysborough, N. S.
" *chrysantha* Mx.
Heracleum lanatum Mx., Torbay, N. F.
Carum carui L., Guysborough, N. S. Escaped and become a very troublesome in meadows.
Aralia nudicaulis, L., Cape Broyle, N. F.
Cornus canadensis L., Guysborough, N. S.; Arichat, Cape Breton island, and Broyle, N. F. Very abundant.
" *stolonifera* Mx., Cape Broyle, N. F.
Linnæa borealis Gronov., Cape Broyle and Bay of Bulls, N. F. Forming dense mats on the exposed rocky hillsides.
Viburnum nudum L., Cape Broyle, N. F.
Galium asprellum Mx., Guysborough, N. S.; Torbay, N. F.
" *trifidum* L., Arichat, Cape Breton island.
Aster æstivus Ait., Cape Brovle, N. F.
" *lævis* L., Cape Broyle, N. F.
" *nemoralis* Ait., Open Hall, Bay of Bulls, N. F.
" *puniceus* L., Cape Broyle, N. F.
Diplopappus umbellatus Torr. et Gr., Cape Broyle, N. F.
Solidago thyrsoidea E. Meyer, Cape Broyle, N. F.
" *altissima* L., Cape Broyle, N. F.
Achillæa millefolium L., Torbay, N. F.
Senecio vulgaris L., Torbay, Cape Broyle, N. F.
Centaurea nigra L., Torbay, N. F.
Leontodon autumnale L., Guysborough, N. S.
Nabalus nanus D. C., Torbay, N. F.
Campanula rotundifolium L. Torbay, N. F.
Vaccinium canadense Kalm., Cape Broyle, N. F.
" *macrocarpum* Ait., Arichat, Cape Breton island.
" *oxycoccus* L. Arichat, Cape Breton island.
" *pennsylvanicum* Lam., Cape Breton island.
" *vitis-idæa* L., Open Hall, N. F.
Chiogenes hispidula Torr. et Gray, Guysborough, N. S.
Kalmia angustifolia L., Arichat, Cape Breton island; Cape Broyle, N. F.
Ledum latifolium Ait., Cape Broyle, N. F.
Pyrola elliptica Nutt., Guysborough, N. S.
" *secunda*, Open Hall, N. F.
Plantago maritima L., Guysborough, N. S.
Trientalis americana Pursh., Cape Broyle, N. F.
Lysimachia stricta Ait., Guysborough, N. S.
Veronica chamædris L., Guysborough, N. S. Found quite abundant in a sh ravine.
" *serpyllifolia* L., Torbay. N. F.; Guysborough, N. S.
Euphrasia officinalis L., Guysborough, N. S.; Arichat, Cape Breton island.
Rhinanthus christa-galli L., Guysborough, N. S.; Cape Broyle, N. F.
Melampyrum americanum Mx., Arichat, Cape Breton island.
Lycopus virginicus L., Bay of Bulls, N. F.
Brunella vulgaris L., Arichat, Cape Breton island.
Scutellaria galericulata, Guysborough, N. S.
Galeopsis tetrahit L., Open Hall, N. F.
Myosotis verna Nutt., Torbay, N. F.
Ipomœa pandurata Meyer, Guysborough, N. S.

Urtica dioica L., Torbay, N. F.
Juniperus communis L., Bay of Bulls, N. F.
Larix americana Mx., Bay of Bulls, N. F.
Habenaria lacera R. Br., Guysborough, N. S.
Goodyera repens R. Br., Open Hall, N. F.
Spiranthes romanzoviana Cham., Carbonier, Cape Broyle, N. F.
Calopogon pulchellus R. Br., Arichat, Cape Breton island.
Juncus effusus, Arichat, Cape Breton island.
Carex rostrata Mx., Arichat, Cape Breton island.
" *vulgaris* Fries, Arichat, Cape Breton island.
Agrostis vulgaris With., Cape Broyle, N. F.
Festuca ovina L., Redcliffe island, N. F.
Poa annua L., Guysborough, N. S.
" *debilis* Torr., Cape Broyle, N. F.
Aspidium spinulosum Suz., Cape Broyle, N. F.
Lycopodium annotinum L., Bay of Bulls, N. F. —*Henry L. Osborn.*

BOTANICAL NOTES.—The new "students' garden" at Kew is an excellent design, well calculated, if properly cared for, to foster a knowledge of botany, and excellently adapted to impart an idea of what botany means to the many thousands of visitors who make excursions to the gardens. The *Gardeners' Chronicle* has recently advocated the establishment of "school gardens," where practicable, and we see no reason why they should not be established wherever there is a public park. In several continental countries they can be counted by hundreds, and in the country of Linnæus by thousands.——In a recent paper on the impurities of drinking water caused by vegetable growths, published by Prof. W. G. Farlow in the first annual report of the Massachusetts Board of Health, attention is especially called to the Nostoc group. These bluish-green algæ so long as they are living and not excessively abundant, produce no perceptibly bad effect on the water, but when they decay in large quantities they give rise to the pig-pen odor, as it is called, which has in recent years caused considerable trouble and still more alarm. The water thus affected becomes too offensive to drink, and cannot be entirely purified by filtering. No absolute remedy is suggested or probably can be, but ponds should be cleared of weeds and substances in which the nostocs may lodge and develop, and the water in the pond should not be allowed to fall rapidly. One of the two plates illustrates the harmless desmids, etc., and the second the injurious nostocs.——It appears that the Ningpo hats, of which 15,000,000 were exported in 1877, many being sold in the Southern United States, are made from a sedge, *Cyperus tegetiformis.* ——The development of the colors of flowers is discussed by Dr. Hermann Müller in *Kosmos.*

ZOÖLOGY.[1]

A RELATION BETWEEN METEOROLOGY AND THE GRASSHOPPER OR LOCUST PEST.[2]—In the winter of 1877–1878 I made a short

[1] The departments of Ornithology and Mammalogy are cond[illegible] COUES, U. S. A.

[2] Read before the National Academy of Sciences.

preliminary study of some of the relations of climate to the so-called "locust pest" of our Western States. An abstract of my results was published in chapters VII (pp. 203–211) and XV (pp. 424–432) of the "First Annual Report of the U. S. Entomological Commission for the year 1877 relating to the Rocky Mountain Locust, &c., &c."

Although the results then arrived at were crude because of the paucity of proper material, yet as nothing better has since then appeared and as the subject has not come to the notice of some who might aid in securing further precise data, I will take the liberty of bringing the matter to the attention of the naturalists of the Academy, to whom we must look for the accurate determination of the thermal constant that we need in order to attain to results that may be practically useful to the community—premising only that I have merely broken the ground for some one else to build.

My idea is that it would be an important advance toward protecting the agricultural districts if we were able at any day to say: "Up to this date the grasshopper eggs have been rapidly (or slowly) progressing towards hatching, and they are now within five (or other number) days of appearing."

But in order to accomplish this we must know the normal time of incubation, which probably must depend principally upon the temperature to which its egg is exposed, and upon the peculiarity of the locust egg as an organized body having the inherent vital power of development.

The meteorologist and the biologist must here work in union. I have, however, presumed for the first effort to undertake at least an approximate solution of both questions, and present here the conclusions that are given at greater length in the pages before referred to.

I. The Heat of Incubation.—It may be assumed that in these eggs, as in all similar animal and vegetable germs, a certain definite amount of heat represented by an exposure for a definite number of hours to a uniform, definite temperature will always effect the hatching of the young. From the study of the observations made by Dr. C. V. Riley, I concluded that at temperatures below 50° Fah., the development of the egg progresses very slowly if at all—although the vitality is not destroyed by temperatures of 15° F. I found that the few available observations led to the following approximations:

1.	At a uniform temperature of	50° F.	the eggs require	65	whole days	or	1560	hours	to hatch.
2.	"	"	60°	"	"	60	"	"	1440	"	"
3.	"	"	70°	"	"	55	"	"	1320	"	"
4.	"	"	80°	"	"	50	"	"	1200	"	"

It may be that at higher temperatures the development proceeds at a more rapidly increasing rate; indeed, one correspondent says that at a temperature of 100° F. the eggs hatched out in a few hours—but nothing is known as to whether the eggs were fresh or not, and the observer's name itself is also unknown, there-

fore I have restricted the above table to that range of temperature within which we have satisfactory observations, and which corresponds most nearly to what generally occurs in practice.

The above table may also be put in the general algebraic form:

$$\begin{array}{ll}\text{In hours} & H = 1560 - 12\,(T - 50^\circ) \\ \text{In days} & D = 65 - \tfrac{1}{2}\,(T - 50^\circ)\end{array}$$

where T represents the average temperature to which the eggs are exposed. We see from this that the heat received by the eggs while resting for sixty-five days in a light, dry, sandy soil at a uniform temperature of 50° F. is the least that will hatch them, while the additional term $\frac{1}{2}$ (T—50°) represents the acceleration of the process consequent upon maintaining a higher temperature.

II. The Temperature experienced by the Eggs in the Ground.—In order to apply the results of the preceding section we must know the temperature of the ground in which the eggs are deposited, that is to say especially the duration of such temperatures as are above 50° F.

Actual observations of the soil at depths of one-half, one, one and a-half, two inches, &c., are, so far as I know, sadly lacking in this country, and rarely to be found in Europe, although very much needed in special investigations. An exhaustive review of our knowledge on the subject of earth temperatures has been published, during the past year, by Wild, of St. Petersburg, but it is concerned mostly with temperatures at greater depths than six inches, and relates, therefore, to terrestrial physics rather than to agricultural interests.

In the absence of direct observations, I have therefore adopted as a working hypothesis some empirical approximate relations between the air temperatures (published in the annual report of the Chief Signal Officer, Gen. A. J. Myer) and soil temperatures at the depth of one-half inch, from which I have deduced the following table showing for each station the total number of hours in each month during which the eggs must have been exposed to temperatures of over 50° and reduced to an equivalent of 60°.

Month.	Fort Garry. Lat. 50°	Breckenridge. Lat. 46.5°	Yankton. Lat. 42.5°	North Platte. Lat. 41.5°	Dodge City. Lat. 37.5°	Corsicana. Lat. 32.0°
1875.						
July	558	434	496	5[illegible]8	620	744
August	372	310	372	496	558	744
September	324	406	480	540	600	720
October	48	180	275	348	540	600
November	0	36	60	72	264	464
December	0	0	28	60	144	372
1876.						
January	0	0	20	20	120	324
February	0	0	24	64	150	324
March	0	0	0	54	104	464
April	66	78	184	276	324	600
May	324	290	366	464	558	744
June	504	420	480	540	600	720

By adding up the number of hours in each vertical column of

this table, we obtain the total duration of exposure to a hatching temperature of 60° F., or the total progress that the egg has made toward the full complement of 1440 hours required for hatching according to the results of section 1.

For example, eggs laid so late as the 1st of September, 1875, at the respective stations, would have made progress and would hatch about as follows:

Station.	Latitude.	Eggs laid September 1, 1875		Average dates of hatching Riley Locust Plague.
		Will have experienced	Will hatch	
Fort Garry	50°	1264 hours of temperat'e 60° by June 30	Early in July, 1876	June
Breckenridge	46.5	1410 " " " June 30	" " "	3d week in May
Yankton	42.5	1407 " " " May 31	" June "	Middle May
North Platte	41.5	1434 " " " April 30	" May "	First of May
Dodge City	37.5	1404 " " " Nov. 30	During Dec., 1875	April
Corsicana	32°	1320 " " " Oct. 31	" Nov., "	March

This table agrees roughly with the dates published in Riley's Locust Plague, p. 97, but is here given only as a sample of what should be possible when we have a better determination of the heat of incubation and have actual observations of the temperature of the soil. In such case we should week by week, as the season advances, make up a statement of the actual progress of the eggs towards the completion of their period of incubation, thus giving the husbandman abundant warning of the birth of the young insect, and giving him more precise data by which to determine, in any case, the best date to plant or sow in order to avoid the ravages of the pests.—*Cleveland Abbe.*

FORSTER'S TERN IN FLORIDA.—Forster's terns (*Sterna forsteri* Nutt.) were quite common here for two months, November and December, 1879. One specimen was secured. Mr. J. A. Allen (On Mammals and Birds of East Florida) says, "I have no evidence of its occurrence here at this season."—*Thomas W. Wilson, Seville, Volusia Co., Fla.*

AN EARLY SEASON.—This year (1880) the Batrachians were stirring very early. I heard "peepers" (*Hyla pickeringii* Holb.) March 4, and was told that they had been heard twice before (February 29, and the other still earlier date not stated).

February 26 a full-grown *Amblystoma punctatum* was brought to me alive. It was found in the woods. March 30 I saw as many as thirty bunches of eggs of *A. punctatum* in the water. I think this salamander lays its eggs by the middle of March, regardless of cold. For a few days during the last of February and the first of March the weather was warm and spring-like, but after that it became so cold that the pools were coated with ice several times.

Another peculiarity of this season was the excessive drought in May, which dried up several of the pools. Since then the rains have filled them again, but the salamanders have disap-

peared. They were not developed enough at the time to leave the water, and so probably perished.

In one pool I found an abundance of the half-grown larvæ of *H. pickeringii* or *Hyla versicolor*, but they were the only Batrachians seen. Usually one can find as many as six varieties in this place. Either the tree toad larvæ were not hatched, or they have a way of caring for themselves when the water dries up, better than other species.—*S. P. Monks.*

A FRESH WATER JELLY FISH.—An adult medusa belonging to the order Trachymedusæ, allied to Aglauropsis from the coast of Brazil, was observed by Mr. Sowerby in the tank in the water lily house in Regent's Park, London, June 10th. It occurred in great abundance in perfectly fresh water at a temperature of 90° Fahr. Mr. Sowerby observed the medusa feeding on water fleas (Daphnia). The specimens were adult males, and are described by Prof. Ray Lankester in *Nature* for June 17, under the name of *Craspedacusta sowerbii.* It was probably introduced from the West Indies. This is the first instance known of fresh water jelly fishes; Hydra and Cordylophora being, so far as we are aware, the only fresh water Hydroids. The succeeding number of the same journal contains additional valuable descriptions of the same medusæ by Prof. Allman and Mr. G. J. Romanes.

ZOOLOGICAL NOTES.—It seems that kangaroos have increased in the Australian colonies so as to become a serious evil. On one run, in the Stanhope district, it was computed that there were at least 60,000 head of marsupial animals, every one of which will eat as much as a sheep. On a run in Queensland visited by Mr. Inglis, there were 40,000 head of sheep, and the owner had destroyed more than that number of kangaroos.——It is well known that snakes swallow their young in case of danger; Mr. E. G. Blackford now states that ten sharks, two feet in length and apparently about six months old, were taken from the stomach of a mackerel shark *(Lamna punctata)*, as if they had got there to avoid danger. Still it is probable that sharks may eat their young.——Mr. W. S. Ball, of Greensboro, N. C., complains that swarms of honey bees attacked his grapes, "destroying nearly half."——The first part of a new volume, the first, of Bronn's Thier-reichs, on the Protozoa, by Dr. O. Bütschli, has appeared. This will undoubtedly prove to be the best general work on these organisms, and will be of much interest to microscopists. An English work on the Infusoria, by W. Saville Kent, is announced to begin to appear in the autumn in monthly parts. ——In Prof. Newton's article on the goose, in the *Encyclopædia Britanica*, he remarks that the predominance of the white variety in domestication may be due in part to the practice of plucking the birds alive, "for it is well known to bird-keepers that a white feather is often produced in place of one of the natural color that

has been plucked out." The reviewer adds that saddle-galls on horses become covered with white hairs; and that he possesses a black cat which has a white star on its head where it was picked by a fowl in kittenhood.——The stridulating organs of spiders have been described by Westring and Mason Wood; those of still other spiders (*Steatoda guttata* and *Linyphia tenebricola*), of both sexes, have recently been described by Mr. F. M. Campbell.——It is claimed by M. Pasteur that earth-worms carry about the bacteridium germs of the disease called anthrax in their alimentary canal; that the dust of the earth mixed with the infected blood gets blown about the herbage with the worms' excrement, and the cattle devouring the grass become infected.——Soon to be published is Mr. St. George Mivart's "The Cat; an introduction to the study of back-boned animals, especially Mammals."——A number of new species of spiders from the Western and Southern States, though mostly from the Pacific coast of South America, are described by Count Keyserling in the Transactions of the Imperial Zoölogical and Botanical Society in Vienna for 1880.——In an essay in the *Morphologischer Jahrbuch* on the anatomy of dibranchiate Cephalopoda or cuttles, Dr. Brock discusses the phylogeny of these animals. He thinks that the Octopods, or poulps, have been derived from shell-bearing forms, Argonauta having, in the young, the rudiment of a shell capsule, while Cirroteuthis, which is not a true Decapod, has an internal shell; while the ink-bag is originally a part of the hind gut, in Sepia only is it connected by a long efferent duct with the anus. He then asks how Sepia came to retain its shell, when in other cuttles it is simply horny. He thinks that Sepia may be a direct descendant of the belemnites.

ANTHROPOLOGY.[1]

ANTHROPOLOGY AT THE AMERICAN ASSOCIATION.—Of the hospitality and general enthusiasm which characterized the Boston meeting, accounts will be found elsewhere and especially in the *Daily Boston Advertiser* from Aug. 26th to Sept. 2. Our purpose is to give a list of the anthropic papers and a brief sketch of their contents.

1. Ethnology of Africa. A. S. Bickmore.
2. Myths and folklore of the Iroquois. Erminnie A. Smith.
3. Prehistoric altars of Whiteside county, Ill. W. C. Holbrook.
4. Theory of primitive democracy in the Alps. D. W. Ross.
5. Ancient mounds near Naples, Ill. J. G. Henderson.
6. The mounds of Illinois. Wm. McAdams.
7. Prehistoric and early types of Japanese pottery. E. S. Morse.
8. Scheme of the tenth census for obtaining statistics of untaxed Indians. Garrick Mallery.
9. Stone implements from the river drift of New Jersey. C. C. Abbott.
10. Indications of Pre-Indian occupancy of the Atlantic coast of North America subsequent to that of palæolithic man. C. C. Abbott.
11. The probable existence in America of the prehistoric practice of trepanning in the cutting of rondelles or amulets from the skull. R. J. Farquharson.

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

12. The Dacotah tribes. Gen. H. B. Carrington.
13. Textile fabrics of the ancient inhabitants of the Mississippi valley. J. G. Henderson.
14. Engraved tablet from a mound in Ohio. W. J. Knowlton.
15. Japanese caves. E. S. Morse.
16. Ancient agricultural implements of stone. Wm. McAdams.
17. Alabaster quarries, flint mines and other antiquities of Mammoth, Wyandot and Luray caverns. H. C. Hovey.
18. The classification of kindred by the N. A. Indians. J. W. Powell.
19. On the Iroquois languages. Erminnie A. Smith.
20. On the rank of the Indian languages. J. W. Powell.
21. Remarks on the mound-builders. J. F. Everhart.
22. Contemporaneous existence of mastodon and man in America. R. J. Farquharson.
23. Conventionalism in ornamentation of ancient American pottery. F. W. Putnam.
24. On the occurrence in New England of carvings by the Indians of the N. W. coast of America. F. W. Putnam.
25. Sign-language and pantomimic dances among North American Indians. J. G. Henderson.
26. The topographical survey of the works at Aztalan, Wis. S. D. Peet.
27. The military system of the emblematic mound builders. S. D. Peet.
28. Improved stereograph for delineating the outlines of crania. A. S. Bickmore.
29. Feeling and function as factors in human development. Lester F. Ward.
30. The uses of the "chungkee-stone." Alfred M. Mayer.
31. Relation of the archæology of Vermont to that of the adjacent States. Geo. H. Perkins.
32. Exhibition of some gambling games of the Iroquois. Erminnie A. Smith.
33. Parturition in a kneeling posture as practiced by the women of the mound-building and stone-grave peoples. C. Foster Williams.
34. The antiquity of man in Eastern America geologically considered. Henry C. Lewis.
35. A comparison between the shells of Kjökkenmöddings and present forms of the same species. E. S. Morse.
36. Antiquities of Onondaga county, N. Y. W. W. M. Beauchamp.

The address at the opening of the subsection of anthropology, by Major J. W. Powell, the chairman, was upon the social organization of the Wyandotte Indians. This was an original investigation covering the entire sociological system of that tribe. The material was gathered from Gray Eyes, a Wyandotte chief, during a six months' residence in Washington the past year. Below will be found abstracts of the papers in the order of the titles above.

1. Prof. Bickmore exhibited a large map of Africa colored to indicate the distribution of the various races of men over the African continent. The map will be on permanent exhibition at the Museum of Natural History, New York city.

2. Mrs. Smith, having spent a season among the Onondagas with superior facilities for studying their habits, gave a series of myths collected by the people themselves.

3. The prehistoric altars of Illinois are structures made of slabs of undressed stones in two or three layers, about ten inches high, and containing charred remains.

4. Mr. Ross took issue with Mr. Freeman in his theory of the origin of democratic institutions as found at the present time in Alpine communities.

5. The author of this paper is himself an enthusiastic explorer, and exhibited a collection of crania and mound relics which he had exhumed with his own hands. The theory of a homogeneous race of mound-builders appears to be confuted by these investigations. Indeed the author seems to think that there were as many races of mound-builders as there are of modern Indians.

6. Mr. McAdams, an intelligent farmer from that portion of Illinois lying near to the Mississippi bottoms and the mouth of the Illinois river, has spent twenty-five years in the explorations which he described in a straightforward, modest communication which held the attention of the subsection undiminished to its close.

7. Prof. Morse began by saying that the Japanese, as a race, are exceedingly fond of the past, and that in almost every well-to-do tradesman's house could be found a fine collection of ancient objects of interest. The author of the paper is of the opinion that the shell-heap pottery is very ancient, and that the indications of Aino origin are fallacious.

8. Col. Mallery has been employed for the past few months, under the patronage of Gen. Walker and of the Bureau of Ethnology in Washington, in devising a scheme for securing a census of the untaxed Indians of the United States, that will include answers to all questions bearing upon their sociology. This was one of the most carefully prepared and valuable papers read before the subsection.

9, 10. Dr. Abbott is well known as the discoverer of palæolithic implements in the drift gravels of New Jersey. His latest investigations lead him to conclude that there were two areas of population in New Jersey anterior to the modern Indians; the palæolithic people of the drift and a later argillite chipping people, whose implements are found in the marsh deposits overlying the drifts.

11. Dr. Farquharson exhibited a series of crania upon which trepanning had been practiced after death, and among them one or two which gave indications of operation during life.

12. The paper of Gen. Carrington was rather a noble plea for the Indians, founded upon long acquaintance, than a scientific dissertation.

13. Mr. Henderson exhibited before the subsection, specimens of the raw material of every substance known to have been used by the Pre-Columbian Indians in spinning and weaving, models of all the spinning and weaving apparatus of which we have any knowledge, and specimens of all kinds of manufactured articles. The paper was an exhaustive résumé of what has been written on the subject, together with the author's own observations.

14. The tablet was exhibited and resembles very closely the celebrated Cincinnati tablet.

15. Prof. Morse gave an account of personal investigation of

Japanese caves under great difficulties, and the finding of ancient pottery and remains.

16. The agricultural implements described were a set of thin flaked hoes collected on the ground by the author.

17. Mr. Hovey having examined and surveyed the caves mentioned in his paper, described the remains of man and of his industry to be met with therein.

18. Major Powell, with the aid of the entire corps of the Bureau of Ethnology under his charge, has constructed a series of charts to accompany a new edition to his Introduction to the Study of the North American Indians. These charts, by means of simple and graphic symbols, indicate at a glance nine generations, including that of *ego*, four above and four below, also sex, consanguinity, affinity and the effect of marriage upon the gens of the offspring. The paper of Major Powell was an accurate account of the purport of these charts, which are to be lithographed and distributed to all anthropological observers.

19. Mrs. Smith gave a sketch of the grammar and vocabulary of two Iroquois dialects, at the same time presenting a manuscript collection of words and phrases.

20. Major Powell read a very carefully prepared paper, giving the results of a long study upon the structure of our North American Indian languages. As the paper will be published in full an abstract will not be attempted.

21. Mr. Everhart's paper was a recital of his own experiences in mound exploration. A very puzzling slab or tablet was exhibited bearing graphic signs similar to some on the Davenport tablets.

22. The text of Dr. Farquharson's paper was the elephant pipes found near Davenport, and described in the Proceedings of the academy of that place, Vol. II, p. 348.

23, 24. Mr. Putnam's papers will appear in detail in the Annual Report of the Peabody Museum, Cambridge.

25–27. We have received no abstracts of these papers.

28. The stereograph of Mr. Bickmore differs from that of Dr. Broca, 1. In the method of fastening the skull to the upright column; 2. In the precision with which the whole may be turned at any angle with the vertical copying surface; 3. In the device for carrying the pen in order to secure a smooth and exact line; 4. In the facility with which the pencil may be reversed. The apparatus is far more expensive than Broca's, but a large number could be made very much cheaper.

29. Mr. Ward's paper was a contribution to the metaphysics of anthropology upon a side which has always interested us, but which has received comparatively little treatment. Man is here regarded as endowed with feelings or desires, involving the effort and activity to gratify them. The gustatory and sexual appetites (and, we would add, desire to be at peace with climatic environ-

ment) are the primary and essential factors. Mr. Ward presented an elaborate schedule of human wants.

30. Mr. Mayer presented to the association a beautiful specimen of a polished "chungkee stone," and from indications upon it argued that the common interpretation of their function is correct.

31–34. No abstracts have been furnished.

35. The purport of this paper may be learned from Mr. Morse's letter in the NATURALIST for September, pp. 656–662.

The next meeting will be held in Cincinnati, with Col. Garrick Mallery as chairman, and Judge J. G. Henderson as secretary. A section of anthropology will then be formed.

The Saratoga volume of the association, just issued, contains the following papers in full:

The Sign Language of the North American Indians, by Garrick Mallery, U.S.A.
On the Explanation of Hereditary Transmission, by Louis Elsberg.
Notes on the Archæology of the Champlain valley, by George H. Perkins.
Mythologic Philosophy. Address of Major John W. Powell, vice-president section B.

UNSYMMETRIC LANCE-POINTS.—While examing the archæological collections of Peter Neff, Esq., at Gambier, Ohio, I discovered a flint lance or arrow-point of such peculiar shape and workmanship as to merit a figure and full description. The piece of flint, 3.25 inches in length by 1.70 inches in greatest width, has been rudely shaped. Across the face of the stone there extends a natural vein having the appearance of a flaw. It is evident that after undertaking to form a lance-point from the whole chipping, the maker changed his mind and concluded to make a smaller and more perfect specimen by ingeniously using this vein for one of the sides. The accompanying figure brings out this fact clearly. The specimen is symmetrical and beautifully formed. Marks from an attempt to break the specimen along the vein, are seen near both extremities. On page 292, Vol. XIII, of the NATURALIST, Prof. Haldeman figured a number of unsymmetrical arrow-heads and allied forms, one of which (Fig. 8) bears so close a resemblance to our specimen as to lead to the inquiry whether the same explanation may not be given in both cases.—*E. T. Nelson, Ohio Wesleyan University.*

Found near Walhonding, Coshocton county, Ohio, in 1879.

GEOLOGY AND PALÆONTOLOGY.

THE BAD LANDS OF THE WIND RIVER AND THEIR FAUNA.—These bad lands are situated in the upper drainage basin of the Big Horn river in Western-central Wyoming. Dr. Hayden, who first reported their existence, has referred them to the Wasatch Eocene (see AMERICAN NATURALIST 1878, p. 831). Explorations which I have recently set on foot and placed in charge of Mr. J. L. Wortman, have resulted in the discovery of an interesting fauna, which quite confirms Dr. Hayden's determination of the age of the formation. Mr. Wortman has obtained nineteen species of *Mammalia*, of which nine are new to science, and five have been already found in the Wasatch beds of New Mexico. The following list is given preliminary to further remarks. Rodentia (1–2); *Plesiarctomys*, two species. Mesodonta; *Hyopsodus*, *Pantolestes*, and *Tomitherium*, one species each (5). Chiroptera.

(6) *Vesperugo anemophilus* sp. nov. Represented by the anterior part of a skull without lower jaw. Dentition, I. ?C. 1; P-m. 2; M. 3. Posterior molar narrow, its posterior external V. rudimental; first and second molars subequal. Fourth premolar elevated and acute, with an external basal cingulum; second premolar simple, acute. Profile steeply elevated behind orbital region, less steep in front of it; zygomas wide. Length from interorbital region to above canine alveolus in front .010; interorbital width .005; width of zygomas .012; do. between outsides of last molar teeth .010; length of molar series .008; do. of true molars .004.

Creodonta. (7) *Protopsalis tigrinus* gen. et spec. nov. *Char. gen.* Probably *Oxyænidæ*,[1] but as the type species is only known from two true molars and a canine of the inferior series with bones of the skeleton, this point remains to be ascertained. Femur with a weak third trochanter. Inferior molars, one like those of *Oxyæna*, *i. e.*, with large heel and internal cusp; another, probably the last, larger, without internal tubercle, and with rudimental heel, thus resembling the inferior sectorial of various existing *Carnivora*. *Char. specif.* Size about that of the tiger or jaguar, exceeding that of any other flesh-eater of the Wasatch epoch. The heel of the smaller tubercular-sectorial is not large, and has a plano-concave superior surface. The principal cusp is much elevated, while the internal cusp is small. The sectorial differs from that of a *Hyæna* in having the posterior cusp more and the anterior cusp less elevated; the heel is only a strong posterior cingulum, which is continued as a narrow line along the inner base of the tooth. A rough cutting ridge forms the posterior inner angle of the principal cusp. There is a wide longitudinal groove of the inner face of the inferior canine whose enamel surface is impressed punctate. The shaft of the femur is nearly straight. Diameters of crown of sectorial: anteroposterior

[1] See Proceed. Amer. Philos. Soc., 1880, July.

.025 m.; transverse .014; vertical .022. Length of heel of tubercular sectorial .006; width of same .006. Vertical diameter of base of crown of canine .022. Depth of mandible at last molar .042. Length of femur (condyles inferential) .300; diameter of shaft at middle .034.

(8) *Stypolophus strenuus* Cope. (9) *Stypolophus bicuspis* sp. nov. Smaller than the *S. minor* Filh., hence the least species of the genus. It is represented by a nearly complete skull with entire dentition of both jaws. Premaxillary bones rather elongate; general form of skull that of a civet. Crowns of second and third superior premolars compressed, with a prominent cusp behind the principal one. First and second true molars with two distinct external cusps and a strong external basal cingulum. Inferior first premolar one-rooted; third with a posterior heel, and fourth with strong anterior and especially posterior heels. Heels of true molars well developed (last broken). Length of superior dental series to I. 1, .031; do. of molar series .020; do. of true molars .006. Depth of mandible at second true molar .007; do. at canine .0035. The double lobed third premolar and the smaller size distinguish this species from the *S. viverrinus*.

(20) *Didymictis altidens* sp. nov. Represented by several specimens. The species is larger than the *D. protenus*, but the tubercular molar is relatively smaller, and has the three anterior cusps better developed. The heel of the tubercular sectorial is longer, and the three cusps more elevated than in *D. protenus*. Diameters of latter tooth: length anteroposteriorly .015; do of heel .006; elevation of external side of crown anteriorly .015; width at same point .009. Length of crown of tubercular .009; width of do .006; elevation anteriorly .005.

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Konde, long. 33° 45′ E. and lat. 9° 22′ S., the extremely steep face of the plateau commences, and the ascent from 3300 to 6500 feet above sea level in the country of Nyika was made. The highest point reached was on the Munboya mountains at the elevation of 8180 feet. From these mountains the ground descends through barren woodland till long. 32° 45′ is reached, where the altitude is only 3300 feet. To the west Nyika is bounded by the Chingambo mountains, running north and south and rising to 5000 feet. These mountains are in long. 32° 45′ E. and lat. 90° 5′ S. On crossing them they were found to slope away gradually to the west. They then passed through Mambwe and Ulungu where the wooded ridges rise to 5000 feet to Tanganyika. Mr. Thomson believes the rise in the waters of Tanganyika to be periodical and according to the amount of rainfall.

Leaving Pambete on November 10th, Thomson established a permanent camp for his expedition at Liendwé, on the Lofu river, and then taking a few of his followers advanced into the country of Itawa, occupying a very hilly plateau and exceedingly difficult to march through. "There was not a mile of level ground, but hills followed hills, all of the most precipitous nature, varied only here and there by some lower ridge." The adjoining country of Marungu was also traversed, and presented even more difficulties. "The mountains rise to a height of 7000 feet with smooth rounded outlines, except where they face the lake. Large streams are numerous and must make the country almost impassable during the rains." The people also were most excitable and suspicious, and great difficulty was experienced in overcoming their hostility. As they approached the Lukuga both the country and the people improved; the mountains decreasing in altitude, and along the streams the fertile soil supports a large population who were friendly and hospitable. "Early on the morning of Christmas day," Mr. Thomson writes, "from the top of a high ridge I had the pleasure of seeing the Lukuga, as a noble river flowing with rapid movement and whirling eddy away to the far west, unchecked by sand bars or papyrus, and requiring no experiments with straws or other objects to ascertain the existence of a current." The barrier seen by Stanley was found swept away; the river, narrowed at this point, rushing through with great force so as to be utterly impassable for canoe or boat. "The barrier of mud and papyrus was swept away either two or three years ago, the waters of the lake having been rising till that time; since then there has been a fall of seven feet, according to the observations of Mr. Hore at Ujiji, who was also the first to see the Lukuga as an indisputable river."[1] From here he continued on to

[1] Mr. E. C. Hore, of the London Missionary Society, visited the Lukuga in April, 1879, and found it a large river flowing out of the lake. From the high ridge above the stream he saw it flowing outward as far as the eye could reach towards the Lualaba. Cameron and Stanley both visited the Lukuga in the dry season.—*Editor.*

Kasenge and Ujiji. No details of his return journey have been received as yet. He is known, however, to have followed the Lukuga for many days on its course to the Lualaba or Congo. He then returned by the lake to his camp, and finally reached the coast by a new route past the unvisited Lake Hikwa.

At the same time that Mr. Thomson was crossing from Nyassa to Tanganyika, the journey was being made by Mr. James Stewart, of the Mission station at Livingstonia. He left the former lake at Kambwe lagoon about twenty-five miles south-west from Mbungo, on October 14, 1879.

The ascent to the plateau was not so steep here as the R. G. S. expedition found it to be, and was accomplished in two days, when the elevation of 3900 feet was attained. Continuing to keep to the south-west of the route of Thomson, he found the average elevation of the plateau 4700 feet. The rain fall of the country is large, and its climate cool and bracing. The route over this plateau was a remarkably easy one, gradually rising from 3900 feet to 5400 at the ridge overlooking Tanganyika, and there is not one difficult ascent. The descent to the lake is gradual, and took two days. The distance from Kambwe lagoon to Pambete was found to be 254 miles. Here he met Mr. Thomson and remained with him until his departure, when Mr. Stewart returned to Nyassa, reaching it again on December 3d. The homeward march was only 232 miles in length, and could be shortened probably to 210.

In Chungu he found the trees thickly covered with large caterpillars three or four inches long and as thick as the fore finger. The natives were gathering them in great numbers, to preserve them for food. One kind was a light pea-green color, the other dark with white spots and sharp spines on the back.

MICROSCOPY.[1]

Permanent Microscopic Preparations of Plasmodium.—Mr. S. H. Gage advises picric acid as a means of hardening this interesting motile form of the Myxomycetes, without change of color as by osmic acid, or shrinkage and change of color by drying. Pieces of rotten wood containing plasmodium are placed on moistened microscopic slides, taking care that some of the protoplasm touches the slide, and the whole placed under cover to prevent drying. In an hour or so any plasmodium that may have crawled out upon the slide, may be fixed by placing the slide a few minutes in a mixture of equal parts of ninety-five per cent. alcohol and a saturated aqueous solution of picric acid. Yellow plasmodium may then be at once mounted, through absolute alcohol in balsam; but white forms should be first bleached in twenty-five per cent. alcohol.

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

Permanent Microscopic Preparations of Amphibian Blood.—The very excellent method of drying the corpuscles of mammalian blood on the microscopic slide, is not applicable to the much more bulky corpuscles of Amphibia. The corpuscles of the latter are sure to be distorted and seamed in drying; hence various methods of preserving the corpuscles moist have been tried with varying success.

The following very great modification of the method proposed by Ranvier in his treatise on histology,[1] has been in use for some time in the Anatomical Laboratory of Cornell University, and has given uniformly excellent results. Preparations made three years ago are quite as good as at first.

Three or four drops of fresh blood are allowed to fall into 10 cc. of normal salt solution (common salt 750 milligrams, water 100 cc.) preferably contained in a high narrow vessel like a graduate glass or beaker. The mixture of blood and salt solution should be well agitated and then 100 cc. of a saturated aqueous solution of picric acid added with constant stirring. After the corpuscles have settled, as much of the supernatant liquid as possible is poured off, and in its place is put about an equal volume of normal salt solution. The corpuscles are allowed to settle, the liquid poured off and another volume of salt solution added. This is continued until the salt solution acquires only a faint yellow tinge.

The use of the salt solution is, first, to dilute the blood in order to avoid distortion of the corpuscles, and second, to wash away the picric acid so that the subsequent staining will be more satisfactory.

After pouring off the last salt solution, there is put in its place 10 cc. of a mixture of five parts of Frey's carmine and ninety-five parts of picrocarmine. The corpuscles will stain in from one to fifteen hours. A drop of the agitated mixture should be examined occasionally to ascertain when the staining is sufficient. The nucleus should be deep red, and the body of the corpuscle yellow or pinkish.

When the staining is completed, as much stainer as possible should be poured off, and in its place 10 or 15 cc. of acid glycerine (glycerine 100 cc., acetic or formic acid 1 cc.). This mixture of corpuscles and glycerine may be placed in a bottle and used at any time, it being simply necessary to agitate the mixture slightly or to take up some of the sediment with a pipette and mount it precisely as any other glycerine preparation.

Summary.—1. The fresh blood is first diluted with about fifty times its volume of normal salt solution.

2. To this diluted blood is added ten times as great a volume of a saturated aqueous solution of picric acid.

3. The picric acid is washed away with normal salt solution.

[1] Traité technique de Histologie, p. 195.

4. The corpuscles are stained with picrocarmine, or a mixture of this and Frey's carmine.

5. They are preserved in acid glycerine, and may be mounted for the microscope at any time.—*Read at the sub-section of Microscopy of the A. A. A. S., by Simon H. Gage, Ithaca, N. Y.*

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SCIENTIFIC NEWS.

— The U. S. Entomological Commission had a prolonged session in June, immediately after the adjournment of Congress, and since then the members and their assistants have been in the field. As during the previous year the labor was divided, so that Prof. Riley took charge of the cotton worm investigation, while Profs. Packard and Thomas prosecuted the study of the Rocky Mountain locust in the Western Territories.

The organization of Prof. Riley's parties is as follows:

Prof. Stelle proceeded to Texas, making his headquarters somewhere in the Colorado Bottom, where he was assisted by Judge W. J. Jones, of Virginia Point, near Galveston.

Prof. Barnard made his headquarters at Vidalia, Louisiana, so as to fully study those portions of Louisiana and Mississippi which were neglected in 1878 and 1879 on account of yellow fever.

In Mississippi, Prof. R. W. Jones, of the State University, assisted by Dr. E. H. Anderson, of Kirkwood, and Mr. Lawrence Johnson, of Holly Springs, represented the Commission among the cotton lands of that State.

In Alabama, Judge J. F. Bailey, of Marion, assisted by Mr. James Roane, chemist, of Georgetown, D. C., made a special series of experiments.

In Georgia, Prof. J. E. Willet, of Mercer College, made a series of experiments to test the usefulness of fungus germs in the destruction of the worm, having the aid and advice of W. G. Farlow, professor of cryptogamic botany at Harvard, who has been employed by the Commission to study this subject.

In Florida, Mr. H. G. Hubbard, a well-known entomologist of Detroit, Michigan, who has been for some time stationed at Crescent City, is making a series of practical observations and experiments, having his headquarters at Tallahassee.

Prof. Smith was occupied more particularly with the preparation of maps showing the different cotton regions, and indicating a new classification of the cotton belt with reference to the hibernation of the insect.

Mr. E. A. Schwarz, who has been associated with Prof. Rile from the beginning of the investigation, and Mr. W. H. Patt an experienced entomologist of Connecticut, remained at the he quarters of the Commission in Washington during Prof. Ril

absence, and took the field later in the season at points to which future experience may direct. Prof. Riley has been at various points in Mississippi, Alabama and Georgia. He has traveled from point to point superintending the work and advising with his assistants. Towards the end of September he expects to go to California to investigate the facts concerning the cultivation of Pyrethrum, which may prove a valuable and safe antidote to the çotton worm. He has already taken steps to introduce this plant into the Southern States.

In their investigation of the Rocky Mountain locust, Profs. Packard and Thomas have been assisted by Prof. Aughey and Mr. Lawrence Bruner, of Nebraska, Dr. John Marten, of Carbondale, Illinois, and Mr. Allen Whitman, of Minneapolis, Minn. In Utah, Messrs. J. L. Barfoot, Orson Howard and Mr. E. E. Wood, of Chicago, have rendered assistance.

Prof. Packard visited Wyoming and Utah, while Mr. Bruner, his assistant for Montana, left home July 1st, going from Bismarck overland to Fort Keogh, and thence up the Yellowstone valley to Bozeman. When last heard from he was at Helena *en route* for Benton. He was in the field two months.

Prof. Thomas left Carbondale on the 10th of July for an extended exploration of those parts of Dakota and British America which embrace some of the most important regions in the permanent breeding grounds of the locust.

The result of the locust investigations for this season shows a remarkable immunity from the attacks of *Caloptenus spretus*, the species of locust under consideration. A single swarm was observed in Utah, and local scattered flights of inconsiderable importance in Dakota and Minnesota, and Eastern Oregon, near Walla Walla. For the first time for many years Montana has been free from the locust, only scattered individuals having occurred in the Yellowstone valley. The researches of the Commission now carried on for four seasons has cleared up the question of the permanent breeding grounds of the locust, which exists in Montana, in the valleys of the Upper Missouri, the Judith basin and the Yellowstone valley with its tributaries. From this region the swarms visit the border States to the eastward, and also pass down into Utah and Wyoming. Colorado is mostly visited by swarms local to that State, while large swarms have arrived from Wyoming in former years. The second report of the Commission is in press and will appear in November, and the third is in preparation.

The investigation of the locust will be resumed in the spring of 1881, Prof. Packard designing to spend the month of June in portions of Utah, Idaho and Montana, so as to bring the work down to June 30th of next year, when by law the special field work connected with the investigation of the Rocky Mountain locust ceases. It is believed that this locust will never be so destructive as in the

past, and due credit has been given by disinterested persons in Kansas, Nebraska, Colorado and Utah, to the practical value of the efforts of the Entomological Commission in obtaining and diffusing such a knowledge of its breeding habits, migrations and distribution as to abundantly justify Congress in ordering the investigation.

— In a long review of Prof. Hayden's 11th Annual Report of the Geological and Geographical Survey of the Territories in the number of *Nature* for July 22, 1880, Prof. A. Geikie, of Edinburgh, expresses the views of nearly all the scientific men in this country and in Europe, in the closing paragraph, which we transfer to our pages. " There will be, we presume, one further report for 1878—the last year of the existence of the Geological and Geographical Survey of the Territories. Though this mode of annual publication necessarily involves incompleteness, and is apt to overload the reports with unimportant detail, there can be no doubt that the series of volumes issued by this Survey form a permanent record of great value, which for the districts to which they refer, will serve as the basis of all subsequent work. It is not without regret that one can regard the cessation of these volumes. On this side of the Atlantic, where they can be calmly considered apart altogether from scientific rivalry and political entanglements, they have been received with general approbation. It is impossible not to be struck by the largeness of the plan conceived by Dr. Hayden for the scope of his survey. Not geology merely but every branch of inquiry touching the natural history, archæology, geography and meteorology of the Territories, was embraced within his plan, and has been illustrated as far as the means at his disposal would allow. To have conceived this broad and scientific scheme, and to have possessed the administrative power to secure and keep in working concert so large and able a body of observers, are qualities of no mean order, and deserve grateful recognition wherever an intelligent interest is taken in the general progress of science and in that human advancement which scientific progress insures."

— S. S. Haldeman, Professor of Philology in the University of Pennsylvania, died at Chickis, Penna., September 10th. He was born near Columbia, Penna., in the year 1812, and received his education at Dickinson College. He was chosen assistant in the New Jersey Geological Survey in 1836, and in the succeeding year occupied a similar position in the Pennsylvania Geological Survey. While engaged in the latter capacity he made some important discoveries which received marked attention at the time, among them that of the oldest fossil known at that time. From 1851 to 1855 he occupied the chair of Natural History in the University of Pennsylvania. In that year he took the same positi in Delaware College, and at the same time became professo

Geology and Chemistry in the Agricultural College of Pennsylvania. He was the author of numerous articles on conchology, entomology and palæontology, published in the various scientific magazines. His work, entitled "Analytic Orthography," consisting of investigations into the philosophy of language, obtained for him in England, the highest Trevelyan prize over eighteen competitors in 1858.

— Mr. G. D. Smith, of Boston, died of paralysis August 6th, aged 46. He was a member of the firm of Palmer, Bachelder & Co., Boston, but was, from boyhood, a student and lover of nature. He devoted himself especially to the Coleoptera, amassing a collection of about 13,000 species, North American and exotic, probably the largest private general collection of Coleoptera in the country. Mr. Smith published no scientific papers, but aided museums and entomologists by the loan and gift of specimens, and thus fostered the zeal of amateurs and local collectors. He was modest, amiable, generous and most industrious, and a loss to the entomologists of Cambridge and Boston, by whom he was held in high esteem. We understand that Mr. Smith's collection is for sale; it would serve admirably as a general collection for a college or university museum.

— Dr. Charles T. Jackson, well-known as a pioneer in American geology and mineralogy, died at Somerville, Mass., Aug. 29th. He was State Geologist of Maine (1836–8), Rhode Island (1839), and New Hampshire (1840), in 1847–50 was U. S. Surveyor of mineral lands in Michigan. He was the author of many geological and mineralogical essays. Dr. Jackson was born at Plymouth, Mass., June 21, 1805.

— Two eggs of the extinct great auk were sold by auction in Edinburgh recently, both being purchased by Lord Lilford, one at £100, the other at 102 guineas—probably the largest sum ever paid for a single egg, with the exception of that of the moa, a single specimen of which was sold at the same place, in 1865, for £200.

— Messrs. A. F. Gray and R. E. Call invite the coöperation of American conchologists in providing the necessary material for a monograph of the Unionidæ of North America. It is designed to figure the anatomy of every species in detail, hence shells with their animals carefully preserved in alcohol are desired.

— An appropriation bill passed by the U. S. House of Representatives provides for a survey of the Gulf Stream from its origin to the Saragossa sea. The plan embraces soundings, deep-sea temperatures and observations of the currents.

— La Opinion Nacional of Caraccas, Venezuela, is publishing a series of articles by A. Ernst, on injurious insects and their

parasites. The *Miris maidis* and *Empusa muscæ* have been discussed.

— Three excellent papers on the three climates of geology, by C. B. Warring, have lately appeared in the *Penn Monthly*. They are mainly critiques of Croll's speculations.

— Mr. George A. Bates, Naturalist Bureau, Salem, Mass., announces the publication of Life on the Sea-Shore, or the Marine Animals of our Coasts and Bays, by James H. Emerton.

— Prof. A. E. Grube, of the University of Breslau, died June 3d. He was born in 1812, and will be remembered by his valuable treatises on the invertebrates, especially the worms or Annelides, in the knowledge of which he was *facile princeps*.

— Prof. E. B. Andrews, of the Geological Survey of Ohio, and author of one of its final reports, died Aug. 21st, aged 59.

— Gen. A. J. Myer, the head of the U. S. Signal Service, died Aug. 24th, aged 51.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Association for the Advancement of Science, Twenty-ninth Meeting, Boston, Aug. 25 to Sept. 1, 1880.—This proved to be the largest meeting of the association ever held, and the members received a right royal welcome from the citizens of Boston. The address of the retiring president, Prof. George F. Barker, was on "Some modern aspects of the Life Question." He said that at the outset a reply to the great question, What is Life? must be evaded by the assertion that the answer is not yet. However, one of the greatest results of modern research has been to establish the fact that living organisms have been brought absolutely within the action of the law of the conservation of energy, and that whether it be plant or animal, the whole of its energy must come from without itself; in fact, an animal like a machine only transforms its energy. Lavoisier's Guinea pig placed in the calorimeter, gave as accurate a heat return for the energy it had absorbed in its food, as any thermic engine would have done. He next referred to the origin of muscular contraction, and arrived at the conclusion that it was due to electrical phenomena, adding the interesting fact that the electrical discharge was not carried to the muscle by the nerve, but was generated within the muscle itself. He said in conclusion that physiologically considered life has now no mysterious passages, no sacred precincts into which the unhallowed foot of science may not enter, and that research has day by day diminished the phenomena supposed to be vital, and that sooner or later every action of the living body will be pronounced chemical or physical."

The address of Mr. Alexander Agassiz, vice-president of sec-

tion B, was entitled, "Palæontological and Embryological Development." The speaker referred to the remarkable parallelism between the embryonic development of the members of a group and its palæontological history. This parallelism, which has been on the one side a strong argument in favor of design in the plan of creation, is now, with slight emendations, doing duty on the other as a newly discovered article of faith in the new biology.

As a demonstration of the truth of such a parallelism, he presented a series of facts and generalizations resulting from his studies of the fossil and recent sea-urchins. In closing he insisted on the impossibility of tracing in the palæontological succession of the Echini anything like a sequence of genera. "No direct filiation can be shown to exist, and yet the very existence of persistent types, not only among Echinoderms, but in every group of marine animals, genera which have continued to exist without interruption from the earliest epochs at which they occur to the present day, would prove conclusively that at any rate some groups among the marine animals of the present day are the direct descendants of those of the earliest geological periods. When we come to types which have not continued as long, but yet which have extended through two or three great periods, we must likewise accord to their latest representatives a direct descent from the older." * * * "Such descent we can trace, and trace as confidently as we trace a part of the population of North America of to-day as the descendants of some portion of the population of the beginning of this century. But we can go no further with confidence, and bold indeed would he be who would attempt even in a single State to trace the genealogy of the inhabitants from those of ten years before. We had better acknowledge our inability to go beyond a certain point; anything beyond the general parallelism I have attempted to trace which in no way invalidates the other proposition, we must recognize as hopeless."

Prof. A. M. Mayer read an eulogy on the late Prof. Joseph Henry. The botanists were entertained at the Botanic Garden by Prof. Asa Gray, who read an essay on the vegetation of the Rocky mountains. Prof. A. Hyatt also gave an evening lecture on the transformations of Planorbis as an illustration of the doctrine of evolution.

The following officers were elected for the next year, the meeting to be held at Cincinnati: president, Prof. G. J. Brush, of New Haven; secretary, Prof. C. V. Riley, of Washington; treasurer, Mr. W. S. Vaux, of Philadelphia; president of section A, Prof. A. M. Mayer, of Hoboken; secretary, Prof. John Trowbridge, of Cambridge; president of section B, Dr. W. H. Engelman, of St. Louis; secretary, Prof. William Saunders, of Canada.

Following are the titles of papers read in section B, natural history and geology:

Comparative anatomy as a part of the medical curriculum. Harrison Allen.
Distinguishing species of Populus and Juglans by the young naked branches. W. J. Beal.
Evidences of the effect of chemico-physical influences in the evolution of branchipod crustaceans. Carl F. Gissler.
Observations on Japanese Brachipoda. E. S. Morse.
An investigation of the peach yellows. B. D. Halsted.
Incomplete adaptation as illustrated by the history of sex in plants. L. F. Ward.
Evolution of parasitic plants. Thomas Meehan.
Anthrax of fruit trees; or the so-called fire blight of the pear and twig blight of the apple tree. T. J. Burrill.
Further notes on the pollination of Yucca, and on Pronuba and Prodoxus. C. V. Riley.
Fossil Dinocerata in the E. M. Museum at Princeton, N. J. F. C. Hill.
Origin and succession of Felidæ. E. D. Cope.
Preservation of fossil insects and plants at Mazon creek. J. W. Pike.
Menobranchus lateralis. P. R. Hoy.
The endocranium and maxillary suspensorium of the bee. G. Macloskie.
Anatomy of the tongue in snakes and other reptiles, and in birds. Exhibition of sections. Charles Sedgwick Minot.
The first decade of the U. S. Fish Commission. Its plan of work and accomplished results, scientific and economical. G. Brown Goode.
Partial revision of the nomenclature of the brain. Burt G. Wilder.
The foramina of Monro in man and the domestic cat. Burt G. Wilder.
The *crista fornicis*, a part of the mammalian brain apparently not hitherto described. Burt G. Wilder.
Plan of the cerebro-spinal nervous system. S. V. Clevenger.
The Cupriferous series in Minnesota. N. H. Winchell.
The excavation of the upper basin and clove of the Kaaterskill, Catskill mountains, N. Y. Alexis A. Julian.
The Pulmonates of the Palæozoic period. J. W. Dawson.
On the summation of muscular contractions. Charles Sedgwick Minot.
Notice of a complete bibliography on Plathelminths. Charles Sedgwick Minot.
Two new methods of fighting injurious insects. A. J. Cook.
Feeling and function as factors in human development. Lester F. Ward.
The metamorphosis of Actinotrocha. E. B. Wilson.
The rhythmical character of segmentation. W. K. Brooks.
The credit of the United States Government. E. B. Elliott.
Additional notes on the army worm (*Leucania unipuncta* Haw.). C. V. Riley.
The Spanish mackerel and its artificial propagation. C. W. Smiley.
Notes on kames and assars of N. E. Iowa. W. J. McGee.
The age of the copper bearing rocks of Lake Superior. M. E. Wadsworth.
Field work by amateurs. Ellen H. Walworth.
Origin of gold placer deposits and formation of nuggets. Thomas Egleston.
Coals of the Galisteo in New Mexico. B. Silliman.
Auriferous gravels of the Upper Rio Grande in New Mexico. B. Silliman.
Extension of the Carboniferous formation in Massachusetts. W. O. Crosby and G. H. Barton.
Subsidence and erosion. A. S. Tiffany.
On maximum synchronous glaciation. W. J. McGee.
The granites in the White Mountain Notch, upon Mount Willard, and their contact phenomena. George W. Hawes.
Eruptive rocks of Mt. Ascutney. C. H. Hitchcock.
Notes on Japanese Pulmonifera. E. S. Morse.
Recent practical results of the cotton worm inquiry by the U. S. Entomological Commission. C. V. Riley.
Mineral discoveries in Western North Carolina. J. T. Humphreys.
Ancient topography in North Carolina. W. C. Kerr.
Recent geology as illustrated in the coast region of North Carolina. W. C. Kerr.
Some points in the structure of mica veins in North Carolina. W. C. Kerr.
A new mode of vein formation. W. C. Kerr.
Condition of the kames and moraines of New England, as bearing upon the date of the glacial epoch. G. F. Wright.

Occurrence of tin at Winslow, Me. C. H. Hitchcock.
On the gravel deposits of Kentucky. J. R. Proctor.
On several horizons of Breccia in Kentucky. J. R. Proctor.
Method of preparing and mounting wings of micro-lepidoptera. C. H. Fernald.
The contributions of the Cambridge Entomological Club to the progress of entomology. B. Pickman Mann.
The life-habits of certain bee flies (Bombyliidæ). C. V. Riley.
Remarks on tree crickets. C. V. Riley.
Remarks on the early stages of Blepharocera. C. V. Riley.
On biological collections of insects. H. A. Hagen.
The occurrence of *Aletia argillacea* in Wisconsin. P. R. Hoy.
The migrations of the Rocky Mountain locust. A. S. Packard, Jr.
On some very rare insect deformities. H. A. Hagen.
Insects from Copal. D. S. Martin.
Some points in the anatomy of the Coccidæ. E. L. Mark.
Structure and development of certain hymenopterous galls. H. F. Bassett.
Notes on North American Galeodes (Solpugidæ). J. D. Putnam.
Contributions of apiculture to science. A. J. Cook.
Address of the president of the Entomological Club of A. A. A. S. S. H. Scudder.
The honey ants of the Garden of the Gods, Colorado. H. C. McCook.
On *Phoxopteris angulifasciana*. C. H. Fernald.
List of Coleoptera hatched from a few hickory twigs. J. L. LeConte.
On the anatomy of *Prodoxus decipiens*. H. A. Hagen.
On the structure of the mouth organs in the Lepidoptera. E. Burgess.
An essay on lightning bugs. J. L. Le Conte.
On the Hessian fly. H. A. Hagen.
On some rare insect deformities. H. A. Hagen.
On the classification of the Tortricidæ. C. H. Fernald.
Generic characters in the Noctuidæ. A. R. Grote.
Scheme of the tenth census for obtaining statistics of untaxed Indians. Garrick Mallery.
Exhibition of stone implements from the river drift of New Jersey. C. C. Abbott.
Indications of a Pre-Indian occupancy of the Atlantic coast of North America, subsequent to that of palæolithic man. C. C. Abbott.
The Dacotah tribes. H. B. Carrington.
Alabaster quarries, flint mines and other antiquities recently found in Mammoth, Wyandot and Luray caverns. H. C. Hovey.
Textile fabrics of the ancient inhabitants of the Mississippi valley. Pt. I. Material. Preparation of material and spinning, illustrated with specimens of bark, spindle whorls, models of spindles and cuts. J. G. Henderson.
Engraved tablet from a mound in Ohio. W. J. Knowlton.
Japanese caves. E. S. Morse.
Ancient agricultural implements of stone. Wm. McAdams.
The Indian question. D. A. Lyle.
The classification of kindred by the N. A. Indians. J. W. Powell.
On the Iroquois languages. Miss Erminnie A. Smith.
On the rank of Indian languages. J. W. Powell.
Remarks on the mound-builders. J. F. Everhart.
Contemporaneous existence of mastodon and man in America. R. J. Farquharson.
Conventionalism in ornamentation of ancient American pottery. F. W. Putnam.
On the occurrence in New England of carvings by the Indians of the north-west coast of America. F. W. Putnam.
Sign language and pantomimic dances among the North American Indians. J. G. Henderson.
The topographical survey of the works at Aztalan, Wis. S. D. Peet.
The military system of the emblematic mound-builders. S. D. Peet.
Improved stereograph for delineating the outlines of crania. A. S. Bickmore.
The uses of the "chungkee stone." Alfred M. Mayer.
Abundance of microscopic forms of life in the central and lateral surfaces of ponds. Eph. Cutter.
The value of the water shed and water supply of the globe. F. L. Capen.
The antiquity of man in Eastern America geologically considered. Henry C. Lewis.

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THE ISLAND OF DOMINICA.

BY F. M. ENDLICH.

DOMINICA has always been veiled in a halo of mystery. Vague rumors of "smoking mountains," of springs flowing "liquid sulphur," and of caverns of prodigious dimensions have invested it with more than ordinary interest.

The island was discovered by Columbus on his second westward voyage in 1493. It belongs to the "Windward Group," the whole of which form a portion of a circle directly east of the Caribbean sea. Geographically Dominica is located about at N. lat. 15°, and 61° long. W. of Greenwich, and its climate, consequently, is subtropical. Without entering into details, which here would carry us beyond our limits, it may be said that the entire Windward Group belongs to one geological system. Generally speaking we may regard these islands—excepting Antigua, Barbadoes and Trinidad—as the highest remaining portions of an extensive eruption, the age of which falls near or into the Eocene period. From their orographic character, as well as from their relative position, the temptation is great to consider them the projecting points of the eastern side of one huge, serrated crater-rim. Detailed observations are too meagre as yet, however, to attempt the establishment of any such hypothesis. Lithologically speaking the erupted material shown on Dominica strikingly resembles that of the southern Wasatch range. Even in special arrangement of the trachytic series the analogy is remarkable. It is furthermore borne out, on this and other islands, by the general contours of elevations, and by the similarity of the effects produced by extensive erosion.

Rising abruptly from the sea, the shores of Dominica afford

comparatively few landing places, and unless a shelving beach can be found, the boat may not unfrequently be swamped in an attempt at landing. Owing to the character of the rocks composing the body of the island, erosive action has been productive of varied results. The immediate base is composed of hard, compact sanidine-trachyte; overlying occurs a series of easily decomposing conglomerates, while the higher portions are again formed by trachyte. In giving these facts, it may be stated that the southern end of the island is spoken of. Towards the high interior and north, but few explorations have been accomplished. Wherever the more easily yielding conglomerates have been attacked by erosive agents, almost vertical walls and narrow gorges are found. Steep slopes are not wanting in the trachytes proper, but they seem to be owing less, perhaps, to erosion than to be the expression of original contour.

Towards the interior the highest mountain reaches an absolute elevation of 5500 feet; within a very few miles of shore, however, 3000 to 3500 feet are attained by a number of peaks. It would be difficult to imagine any more beautiful spot than the southern end of Dominica. Combined with outlines which resemble the rigid stability of Alpine scenery is the luxuriant, sub-tropical flora. An abundance of moisture, equable temperature and absence of the destructive hand of civilization allow full scope for the development of plant life, and have preserved for our admiration a region which cannot fail to call forth enthusiasm. Few sights can be more charming than that of a high, vertical wall clothed throughout with abundant vegetation, exhibiting numerous shades of vivid green. The Roseau river is the most important watercourse of the island. It heads in the higher mountains, flows in a westerly direction, forms a fine waterfall near Laudat, and enters the sea on the leeward side of Dominica at the main port, the town of Roseau.

From the earliest days, since its discovery, Dominica has been a bone of contention between England and France. Ample fortifications, now allowed to decay, speak of the importance which each nation attached to its possession. By the treaty of Fontainebleau it was ceded to Great Britain, but in 1802 was again recovered by France. Finally, in 1814, the former power once more added it to her list of colonies, and has retained it since that time. At the time of its discovery, and for many years after,

Dominica was one of the favorite resorts of the Caribs. This warlike nation here found mountains and water, fish in plenty and fruits in the valleys. From their strongholds in wild fastnesses they more than once issued upon aggressive warfare and severely harassed the settlers of neighboring islands. In the course of years, however, the Caribs have become greatly reduced in numbers, until to-day there is but a mere handful remaining. It is certainly a subject for serious reflection to note the almost complete extermination of a once powerful people by the advance of civilized measures and by superior instruments of aggressive warfare. In view of our own vexed Indian question we may feel inclined to allow personal or national interests to warp judgment or to subvert justice. When, however, the same spectacle is seen from the standpoint of an unimpassioned observer, it assumes a totally different aspect. Dominica and Trinidad are said to contain the last surviving Caribs. On the former island perhaps one thousand may still be living, on the latter not so large a number. Secluded in the mountains of the interior, they are but rarely seen at the settlements. Chivalrous as they formerly were, they have retained to some extent their tribal characteristics of veneration for hereditary and accidental authority and good treatment of their women. These latter have been accustomed to wait upon the "lords of creation" most assiduously, and are rewarded by respect and far more consideration than is usually found among savages. In spite of former cannibalism the Caribs have often shown traits of greatness and magnanimity. At present they occupy a reservation set apart by the government. Peaceably passing their time, they devote their energies to the manufacture of exceedingly tasteful baskets. Double plaiting renders the latter waterproof, and the careful work bestowed upon them is recognized by the numerous uses to which they are put.

In physical appearance these people closely resemble the nobler tribes of our North American Indians; long, straight, black hair falls down over their shoulders; the cheekbones are prominent, nose flattened somewhat, mouth broad and chin massive. Much lighter than the negro population, the color of their skin is yellow to brown. The influence of intermarriage between negro and Carib is plainly perceptible in their descendants. A decided lightening of color, an improvement in features and stature as well as decreased curliness of the hair, denote the pres-

ence of blood which for many years controlled the Windward islands. Many of the girls belonging to this class, who may be found some distance away from the coast, are really quite prepossessing in appearance.

A total population of about 26,000, of which Roseau claims 3000, is ascribed to the island. As might be expected, the constant change of ruling power has had a detrimental effect upon the language spoken by the present population. Defying alike the Parisian and the Englishman, a French patôis is used as the means of lingual communication. Indolence in properly framing words on the part of the negro inhabitants, and perhaps an admixture of some Carib phrases or intonations have rendered it difficult for any one but a resident to understand what is spoken. Very few Caucasians are living on Dominica, as the mountainous character of the colony forbids extensive enterprises. Coffee was introduced, during the last century, from Martinique, and was formerly largely cultivated. Recently, however, an insect has attacked the delicate leaf and destroyed the plants. Experimentally the Liberian coffee-plant has been introduced, and it is hoped that its thick, hardy leaf may successfully withstand the ravages to which the other has succumbed. Limes are raised in great quantities, and have become so thoroughly acclimated that they flourish without requiring any particular attention. Citric acid is manufactured from them and exported. One of the staples is sugar, but the annual production does not exceed a few thousand tons.

From the appearance of the town of Roseau, some inferences may be drawn as to the struggles which were made for possession of the island in times gone by. A dyke, capable of being fortified, protects the water front, while forts, located on the "Mornes" near the town, were destined to keep at bay the invading foe. True, to-day, all of the elaborate defences would speedily fall before the heavy armament of a man-of-war, but at the period of their usefulness they were sufficiently formidable. As the inhabitants are mainly negroes, the town does not present an imposing array of fine structures. Small, wooden huts, thatched in part, protect their families from rain and storms. Illustrating the good taste shown on all these islands, there is a "Public Garden" near the town; fountains cool the air, and conveniently placed seats invite the seeker after shade and the admirer of scenic beauty.

During our stay on the island (February, 1880), we had occa-

sion to visit several points of interest, thanks to the courtesy of gentlemen living there, and the kind offices of Dr. Brown, of Princeton. Prominent among the "mysteries" of Dominica, the "Boiling lake" and the "Soufreurs" have always held their place. The latter are located near the extreme southern end of the island. Leaving Roseau early in the morning, we were pulled along the coast for six miles by four strong oars. On account of the difficulty in landing at some localities, the boats are without rudders. Their place is supplied by a steersman who ably directs the course by means of a short paddle. Boats used by the negroes are built in the shape of canoes, and are partly sharp keeled dug-outs, the sides being boarded to increase the depth. After we had landed, a very warm climb brought us to the first appearance of chemical changes in the rocks. The feldspathic constituents of the trachyte were thoroughly decomposed, the ground white and dusty with but little vegetation. Some search revealed a number of cavities in the altered material, which were lined or filled with beautiful crystals of sulphur. Although the surface of this decomposed area showed a normal temperature, this increased so rapidly with depth, that at little more than a foot it was unbearable to the touch. Small streams in the vicinity were found to measure 45° C., and the water evidently carried ferric sulphate and alum in solution. Ascending higher, through tall weeds, and plucking guavas on the way, we observed a narrow gully in a rocky mountain side, whence steam was issuing in dense volume. It was a matter of some difficulty to cross a ravine which separated us from this point of greatest chemical activity. Here our colored guides deserted us. Not that their guidance was in the least valuable, but we wanted them to carry specimens. No persuasion, no threat could induce them to follow us to the place where, in their opinion, evil spirits resided. "*They* will throw rocks at you," was their only reply, accompanied by an obstinate negative shake of the head. Who "they" were could not clearly be made out. A prevalent popular superstition regarding evil-minded "mountain spirits," furnished us a clew, however, as to the identity of undefinable enemies. Once within the active region of the Soufreurs it became necessary to be cautious in our movements. The ground was treacherous and of about 60° C. temperature. Small openings lined with crystals of sulphur, steadily emitted sulphurous

gases. At some places it became difficult to breathe, so dense was the volume. After passing over about quarter of a square mile, densely studded with fumaroles, we entered the gorge seen from a distance. Steep, slippery slopes of partly decomposed trachytes here enclosed a narrow stream of water which was found to be heated nearly to the boiling point. Sulphuretted hydrogen was present in great quantities, and hot steam-jets attacked us from the most unexpected quarters. Along the rock-walls we found a number of openings, sometimes nearly half a foot in diameter, from which either steam or gas issued.

> "And it bubbles and seethes, and it hisses and roars,
> As when fire is with water commix'd and contending,"

truly describes what we encountered while slowly climbing upward in the gully. From the bottom, through narrow crevices, by way of cylindrical openings, all around us, steam and gas threatened to bar farther progress. In the bed of the hot creek the water presented an appearance of violent boiling, owing to the rapid emission of large quantities of gas. So thick was the steam at this point that it began to interfere with respiration, and at times our surroundings were entirely shut out from view for several minutes. A large percentage of mineral constituents in the water rendered it totally unfit to drink, even when cooled. Ascending farther in the gorge, escape from which was negatived by barren walls on either side, we finally reached an elevation of about 1200 feet above sea level. Here we found the water cold again, trickling in small streamlets over the rocks. We had escaped from the region of gas and steam and had passed, at the same time, the upper limit of present chemical action. Complete metamorphosis, produced by long-continued decomposition, had placed these rocks beyond the influence of atmospheric agents. Burned out, not now taking part in the phenomena of the immediate vicinity, they remain as mute witnesses of the forces which there must have been at work for ages.

To our satisfaction we were enabled to find in some fragments of fresh and partly decomposed trachyte, the solution of the striking scenes witnessed. Minute crystals or irregular fragments of pyrite impregnate the rock throughout a definite zone. In weight the quantity of this pyrite may amount to about twenty per cent. Moisture in conjunction with atmospheric air will readily decompose this mineral, a process which is accompanied

by generation of heat. Such action will be facilitated and accelerated by the extremely small size of the individual pyritic particles. The postulated reagents are abundantly supplied at the locality in question. In addition to the ferric compound the feldspathic portions of the trachyte are attacked, yield to altering agents, and by increase of volume accompanying chemical change, add their share to the generation of heat. At the same time the decomposing mass is physically disintegrated and then easily removed by natural causes, thus permitting a repetition of the same process, until the supply of unstable chemical compounds may become exhausted. Irregularities of either chemical or physical character within trachytic rocks are by no means of rare occurrence. Should their nature be such as to yield more readily to active reagents than the portions surrounding them, decomposition will progress at a higher rate of speed along certain lines or in certain directions. Thus vents may be formed which besides serving as outlets for gases and liquids, will allow fresh supplies of moisture and air to reach points as yet comparatively intact.

Returning to our darkies we found them unfeignedly surprised to see us still alive, but they evidently concluded that we were reserved for some fate even worse than "having rocks thrown at us."

"Wotten Waven" is another point deserving of special study. A morning ride along the left bank of the Roseau, which led through flourishing lime plantations, brought us to the undisturbed timbered slopes of a subtropical zone. Huge tree ferns overshadowed the narrow path cut into a steep face of trachytic conglomerate, over which we were gradually winding our way upward. It would be impossible to furnish a pen picture capable of giving even a faint idea of the beauty inherent in such a forest. The cool moist atmosphere is refreshing, and every step taken forces admiration from those whose eyes are accustomed to the more sombre grandeur of northern climes. A column of steam slowly wreathing skyward betrayed the presence of Wotten Waven. These "thermal springs" lie about 1600 feet above sea level, but not within pyritiferous trachyte. A short distance from the timber edge we found a creek flowing cold water. Following this down, the first hot springs were soon encountered. Here the water issued from small apertures in trachytic rock

which showed but little decomposition on the surface. Varying temperature, ranging from 85° C. to boiling point, was observed, while the water of the creek measured 68° C. But a few yards to the right, a narrow gully ran off from the creek, ending abruptly in a vertical wall, the lower portions of which were composed of trachyte. In the latter an almost circular opening, about two feet in diameter, led to regions unknown. Standing in front of this opening a regular pulsation within was observed. So far as could be seen, it was the mouth of a somewhat extended cavity into which water rushed simultaneously, at nearly regular intervals, from the two sides parallel with the trend of the ravine. If a comparison be attempted, the total effect might be likened to the noise produced by a ship's engine, accompanied by a similar though slighter tremor. Four pulsations occurred on an average during every seven seconds, and the fifth ejected a large mass of water through the opening. This main "spring" of Wotten Waven must therefore be regarded as a *geyser*. On account of the slippery character of the rocks and the imminent risk of being scalded, the temperature could not be obtained at the moment of emission. As the water flowed off it measured 98° C. Besides this large geyser, numerous small ones occur here, all, however, sending their water in lateral directions, not vertically. In addition to the rock openings ejecting water, there were many from which steam issued. Sometimes this was not visible at the immediate mouth and it became a matter of discrimination as to the selection of standing places. Taking the temperature of several of these jets, we found a maximum of 102° C. Noticeable is the total absence of sulphuretted hydrogen. While at the Soufreurs all the silver we carried with us almost instantly turned black, we could here find no point where bright coins would be at all affected.

Although in a general way the sources of heat are due to the same causes at Wotten Waven as at the Soufreurs, some differences were found. Decomposition is the main factor, but in this instance pyrite is not the material most violently affected. Small quantities of the mineral certainly occur, and it is quite possible that its presence in larger proportion may originally have [illegible] the process of chemical changes. At this locality the [illegible] contain a large percentage of soda feldspar (oligocla[illegible] rapidly decomposing, and by the chemical reaction [illegible]

as by the considerable increase in volume incident thereto, heat is produced. In several instances, where the same changes were going on in rocks containing oligoclase, we have found thermal springs in the immediate vicinity. While decomposition of pyrite is more rapid, it does not extend so far from the surface into the rocks as that of the feldspar. In connection herewith it may be mentioned that the waters of Wotten Waven hold an exceptionally large amount of alumina in solution. In spite of the diminutive size of the majority of the geysers, the quantity of water delivered is considerable. As it nearly all flows off, a very large supply must be furnished by percolation, or by entrance through fissures and along subterranean watercourses.

On January 4, 1880, the inhabitants of Roseau had cause to feel somewhat alarmed. Taking into consideration the mysterious legends as to volcanic activity on the island, it will readily be understood that the appearance of a huge, dark cloud over the town shortly before noon of a clear day, might awaken some apprehensions. More so, however, when that cloud began to "rain down" fine particles of gray, mineral-like material which soon changed the green foliage of all vegetation to its own color. Pompeii and Herculaneum saw the initiation of their destruction in a similar cloud. So far as could be determined by cool observers, among whom Dr. Nichols of Roseau was prominent, the cloud extended for a distance of about eight miles beyond the town and then was lost, going seaward. Even in the latter part of February the finely divided "ash" could be found on many plants. It consisted of very minute fragments of trachytic rock and small crystals and particles of pyrite. The general impression was that a volcanic eruption had taken place at "Boiling Lake."

Neither definite detonations were heard nor seismic disturbances felt by the more critical observers. A low rumbling noise seems to have preceded the appearance of the cloud. Several venturesome explorers determined to investigate matters, but were obliged to return without results, as all access to the lake had been barred by dislodged rocks and earth. During our stay at Roseau a party was organized to visit the lake, and a new road was cut through the forest. Numerous colored attendants, whose climbing qualities and endurance we could not but admire, transported baggage and provisions. R[illegible] several miles

beyond Laudat, we were obliged to relinquish our riding animals and proceed on foot. Wet and slippery the newly cut path followed the sharp crest of a narrow ridge until it reached an absolute elevation of 3200 feet. From here the view was overpowering. Before us lay miles of mountain slopes, utterly denuded of vegetation. Dull gray was the color of the entire surface, and the broken stumps of once gigantic trees spoke eloquently of the terrific force which had laid in desolate waste what but two months before had been a dense primeval forest. Behind us was the beautiful valley of the Roseau, the wooded mountains skirting it and withal an expression of serene repose. To our right steam was fitfully issuing from a crater-like depression, to the left rose a majestic column of white steam from Boiling lake.

We descended a very steep slope and found the "erupted" material to consist of broken and disintegrated fragments of trachyte thoroughly impregnated with pyrite. In other words, we had before us fresh rocks which were analogous to those we found decomposed at the Soufreur and identical with the "ash" which had fallen at Roseau. By far the greater portion of the mass was reduced in size so as to pass through a twenty-mesh sieve. Boulders weighing several hundred pounds were not wanting, however. Arrived at the rivulet at the end of the mountain slope, we found the water to be warm. With the limited amount of time at our command, it was impossible for us to visit the right-hand depression, so we turned our steps towards the lake. The former was the scene of greatest activity, and the place from which the dislodged rock material had issued. Recent disturbances had rendered access so precarious, however, that it would have been necessary to spend more time than we could afford in effecting an entrance to the bottom of the "crater." An inky black creek was crossed shortly, and but a few yards beyond it one of milky whiteness running parallel. Both were warm, about 60° C. Probably the presence of iron sulphides accounts for the color of the former, while the latter, judging from its taste, contained mainly alkalies. As a noticeable fact, we observed that these colors were not merely due to the effect of underlying rocks, but that the water was really so colored. Over rocks, through water, knee deep in yielding mud we scrambled along, until we finally stood at the edge of an oval basin surrounded by almost vertical walls, where the Boiling lake had been. Formerly it must have extended about three hundred by

two hundred and fifty yards, but at the time of our visit the disturbances about one and a-half miles distant had destroyed the lake, leaving only a boiling spring of about fifteen by twelve feet. Here the water issued with tremendous ebullition. It was unsafe to approach within a few feet of the spring after the descent to the former lake bottom had been made, and it thus became impossible to ascertain the exact temperature. The spring was located near the center of the lake bed, from where its water flowed off through a narrow opening in the enclosing walls. Every step was taken on hot ground, and a cane pressed down into the earth would be followed by the hissing sound of escaping steam upon withdrawal. Fortunately we found cold water, at the upper end of the lake, trickling down on the face of a rock, and we were spared the torture of

> "Water, water everywhere
> Nor any drop to drink."

From examinations made we found that the lake had not been *filled up* by masses of rock or soil projected into it, but that the confining dam had broken away and the water had flowed off. In view of the fact that seismic action appears to have been very subordinate at the time of the "eruption," it seems probable that the lake suddenly received accessions of water and thus forced its way downward, carrying with it the former barrier. At best the depth of water, unless perhaps immediately over the hot spring, which once formed an integral portion of the lake, must have been inconsiderable. Its elevation is about 2400 feet above sea level.

Had not personal inspection of the surroundings of the lake been convincing that the "eruption" did not take place there, the evidence afforded by mutilated plants would have been conclusive. No other word but "terrific" can express the conception of the mass and overwhelming force with which rocks and boulders were hurled into the forest. On the southerly side—towards the above-mentioned crater-like depression—the bare broken trunks and stumps of trees, rarely over fifteen feet high, were literally mashed, while comparatively untouched on the reverse. About one-sixth to one-tenth of the total diameter was worn away by repeated concussion, and trees of tough fiber, so much as remained of them, were absolutely torn to shreds. Nowhere did we find indications of heat which might have been sufficiently great to fuse any of the minerals contained in the

trachyte. The reduction of the latter in size was purely mechanical, largely due to attrition, although certainly the force producing it was owing to causes entirely different. We estimated the area thus razed, of timber, at about nine square miles, and the average thickness of deposited lithological material at eighteen inches. Allowing for the fact that the latter was not densely packed, this estimate furnishes a total amount of more than 27,000,000 tons which had been removed from their normal position by catastrophic action.

As to the causes which produced the "eruption," the evidence on hand is sufficient to arrive at some conclusions. First of all, the idea of *volcanic eruption* must be dismissed. No grounds for such assumption can be found, and the immediate vicinity of the scene of action exhibits no trace thereof. On the other hand, the decomposition of pyrite and associated minerals is here the evident source of heat. Water is plentifully supplied by precipitation as well as by superficial and subterranean drainage. If we can assume, and it seems reasonable that we should, that either the supply of heat-producing material had increased without adequate vents for accumulating pressure being in existence, or that the vents, at the time acting as safety valves, were by some means reduced in area of cross-section, then, necessarily, an explosion must follow as soon as the pressure of steam and gases is able to overcome superincumbent weight. Added to this we have learned that decided barometric disturbances were observed on Dominica at a time immediately preceding the catastrophy. In case a bare equilibrium were maintained, certain changes of atmospheric pressure alone might account for a sudden release of gases under pressure. Every indication speaks for the assumption that the phenomenon is to be regarded as an *explosion* and not as an eruption, so far as the latter pertains to vulcanicity.

In the course of a few years the damages so suddenly wrought will have been repaired again. Plant life in this climate is vigorous, and it will seem but a short time ere the now barren slopes will once more be clothed in green. Nothing will remain but some scarred veterans to tell the tale of the disastrous explosion of 1880. Although a repetition of such occurrences may be looked for, the area is too limited and the seat of disturbing chemical action too superficial to endanger the safety of Dominica.

THE SAND-HILL CRANE.

BY HON. J. D. CATON.

SOME observations which I have made of the habits of the sand-hill crane *(Grus americana)* in domestication in my acclimatation grounds, may be interesting, as I am not aware that this interesting bird has been much studied under such conditions.

Seven years ago Father Terry, the Catholic priest in Ottowa, Illinois, presented me with two sand-hill cranes, then three years old. They had run about his house and yards, and in the street of the city near by. They manifested a strong appreciation of the kindness he had shown to them, and whenever he returned home, whether in the day or the night time, they manifested their satisfaction by their loud calls and uncouth gestures. If in the street they were pursued by a dog, they took wing and flew home with the ease and facility of the wild bird, and yet they showed no disposition to leave and revert to the wild state, even at the migratory season of the species.

In my grounds they necessarily received less personal attention and gradually became less attached to man, but could often be induced to dance and play with me in their awkward but very amusing way. They are inclined to be imitative. Forty years ago, when they were very abundant in this country, a farmer whom I well knew, assured me that he had one in domestication which when a year old would fly on to the hay stack and tramp around in imitation of the boy, and would also take the lines in its beak and follow the horses, breaking prairie, for a considerable time, with a stately strut that was very amusing.

For the first year or two in my grounds they were inclined to associate together, but gradually become estranged and avoided each other's society. Indeed for years they avoided each other, and were never seen together. One season one of these birds got into the north park and attached itself to the pigs, which it followed about constantly, and when it returned to the south park seemed quite disconsolate, and kept near the dividing fence where it could see its friends on the other side, and if they came near would greet them with its loud harsh note, which could be heard half a mile away. Several times during the summer she managed to join her unnatural associates and followed them with

a constant devotion; this is the only instance in which I have seen one of these birds attach itself to any other animal in the grounds.

I have never observed these birds to eat grass. When they were abundant here in the wild state, they were considered very destructive to the winter wheat after it had sprung up and attained a considerable growth in the fall. I have seen hundreds together on a wheat field in November, but I was so careless an observer then that I cannot tell whether they took the blades of the plant or the decayed seed or roots. The only food I have observed them to take in my grounds was maize and insects.

There are two ponds of water in the grounds, in which there are small frogs, but I have never seen them step into the water or hang about them as if hunting for food. Others seem to have proved that in the wild state they habitually feast on frogs and small snakes, but if they do this in domestication it has escaped my observation.

When these birds were eight years old, that is two years ago last spring, both laid eggs—two each—both eggs were laid on the bare ground without the least attempt to make a nest, and neither attempted to set upon the eggs, though one of them stood about them for a few days as if to guard them, and made a great outcry if any one came near. The next year (1879) they again laid two eggs each, on the naked ground as before, without any nest. This time one sat upon her eggs with apparent devotion for three days, when, as if appreciating that it was labor lost, she left them without further attention.

Last summer, through the kindness of Dr. Row, of the Chicago *Field*, I obtained a male bird, one year old, as I understood, and placed him in the grounds with the others. He was not quite as large as the adult females. He manifested no disposition to associate with either of them. All three wandered about the grounds separately, though the females when they chanced to meet the youngster treated him as though they regarded him as an intruder.

In October last one of the females was killed by a mink who ate off the head and part of the neck, leaving the body untouched. (The same rascal no doubt killed a pair of Hawaiian geese which I valued above price.) I had it cooked, and though nine years old found it tender and of excellent flavor.

During the winter the remaining pair of cranes were forced into a closer companionship, as they remained about the premises where all the fowls were fed with Indian corn. Early in the spring they manifested their natural instinct by a closer intimacy, and soon became inseparable.

On my return home about the first of June I found the female setting on four eggs in a nest consisting of a slight depression on the border of a bunch of leaves which had been arrested by a pile of brush. The nest was not protected by the brush but quite outside of it. The keeper informed me that she had been thus faithfully employed for four weeks, and I hoped soon to see the young birds and determine the period of incubation. She sat upon that nest with great constancy for four weeks longer, when I ordered the eggs to be removed.

The habit of the cock during this time was quite interesting. He spent most of his time pretty near the nest, and guarded it with great fidelity and defended it with courage. If a cow or a deer came near it he flew at it in a rage, and a few thrusts with his sharp beak sent it away in a hurry, and if he saw a buggy coming in that direction, he raised his coarse harsh voice in so threatening a way as not to be mistaken, and if it came too near he flew at it, attacking either the buggy or the horse, whichever he happened to be nearest, and if it went within say fifteen or twenty feet of the nest, the female would leave the eggs and join in the attack, and the premises were soon cleared. Indeed, my friends who are in the habit of visiting my grounds soon learned to give that family domain a wide berth. In fact he was almost as constant in his watchfulness, and as pugnacious in his conduct as a wild (Canada) gander whose goose was sitting across the ravine.

It was the habit of this cock whenever the hen left the nest to seek for food, to take her place, and do the best he could, but he cut an awkward figure sitting on the nest, for his long legs seemed to be much in his way, while the female had managed to assume rather a graceful position while performing that maternal duty. The eggs probably were not in fact fertilized. I hope to be more fortunate next season, and raise a brood of young sand-hill cranes.

The male is now fully one-third larger than the female, though he is but two years old. Since the nest was broken up both are

constantly together, rarely being seen twenty feet apart. He is as gallant in the defence of his mate as ever. But the other day I picked up the female to examine more closely the red portion of the head when a vigorous thrust of his sharp beak as he flew at me admonished me that he thought I was taking unwarrantable liberties, and the attack was followed up with great vigor till I got the whip and tickled him smartly about the head, when he retreated in tolerable order. In the mean time the female had got quite a way off, which no doubt he thought a good excuse for the discontinuance of the attack.

A word about the color of these birds. One of the females when they came into my grounds had two white feathers on the back, which have proved constant ever since. All the others are of the regulation blue of the species. I think Audubon would have admitted that a ten year old bird was no longer young, and would have despaired of ever seeing it turn into a white *Grus canadensis.*

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ON THE MICROSCOPIC CRYSTALS CONTAINED IN PLANTS.

BY W. K. HIGLEY.

[*Concluded from October number.*]

I shall now take up the species of the family Vitaceæ and in these a wider view of crystals will be presented.

This family gives us a good field for the examination of both raphides and sphæraphides in the same plants. In all the species that I have examined the raphides were the most abundant in the leaves with their appendages, the petiole, and the epidermis of the stem in young plants, while the sphæraphides were more common in the old stems and berry, but were also found, though rarely, in the other parts mentioned for raphides. Crystals in the grape have been known for a long time. In the common cultivated grape, raphides are abundant, but the largest are only found in the leaf and petiole, and at times much smaller ones may be looked for after in the fruit. These crystals, whenever found, test for phosphoric acid and lime. In the pulp of sphæraphides are abundant; those of the fruit stalks

$\frac{1}{1000}$th of an inch in diameter. When a collection of these is met with they form a beautiful field, which I think is only surpassed in beauty by the sphæraphid tissue in the testa of the elm. These crystals would not answer to any of the chemical tests except those for calcium, so that I have reason to believe that the base was combined with some organic acid, perhaps tartaric.

Vitis æstivalis and *V. cordifolia* abounded in both sorts of crystals, but neither were as large as in the common grape. In *Ampelopsis quinquefolia* I found raphides, but they were often free, that is they were not in a close bundle. The sphæraphid tissue is very fine in this species. Each crystal seems to form a nucleus to a single cell. The cells are placed very regularly and symmetrical in form. The blackberries contained raphides in more abundance and of a larger form than those of the grape fruits, but the largest were in the leaves and petioles of the younger shoots. The sphæraphides were not as large as those of the grape. As in the genus Vitis the crystals of this species, except those mentioned last, seemed to contain lime as a base and phosphoric acid.

In this family all the crystals contained in the fruit, except the raphides, gave the tests for lime, but failed to give the tests for the common acids, so that I think it probable that the base was in combination with some organic acid. I expected to find in this family more acicular crystals, but in this I was disappointed.

The next order that I shall report upon, as is well known, is the largest natural order, and is represented by a number of hundred species, it being universal. This family, the Compositæ, is well represented in the Northern States. Raphides are not as common in this family as in the other two, Araceæ and Vitaceæ, but forms of all three classes do occur. I have only found the needle-shaped crystals in the ovary or fruit, and sometimes in the receptacle and involucre. In some species minute cubical crystals occur which dissolve with effervescence in acetic acid. Globular masses of crystals known as inuline are quite common. I did not find the raphides in bundles except in one case, *Achillea millifolium*, which contained in the receptacle, on the average, about twenty raphides in each bundle; in all other cases when raphides were found they were single, which was perhaps due to some disturbance.

In *Inula helenium* I could find no crystals except the globular

aggregate known as inuline. This substance is an organic compound having the composition $C_6 H_{10} O_5$. Miller says that this is a variety of starch, insoluble in alcohol but soluble in hot water. and by boiling with dilute acids it is converted first into dextrine and then into pure lævulose. It forms an insoluble precipitate when its solution is mixed with one of acetate of lead and ammonia is added. I did not attempt to extract it from the root as that is quite a difficult operation to perform. The crystals appear like a globular mass with fissures radiating from the center outwards; iodine when applied to the well-cleaned section, gives with inuline a distinct yellow color. This statement is in direct opposition to that made by Fluckiger and Hanbury (see Pharmacographia under elecampane). The only part of the plant that I had was the root, it being too early for the stem, leaves, etc., so that I am not able to state what might be found in the other parts.

Taraxacum dens-leonis also contains inuline, but in much smaller amount than the last, and also a few sphæraphides, which seem to have no particular location, as they may be found, on close examination, in almost any part of the plant, although rare. They were too small and too few in number to obtain any definite chemical tests with them. Also raphides were present, but only in small numbers and not in bundles.

Cichorum intybus contains inuline but it is in still smaller amounts than in the last.

I also found inuline in the root of *Cirsum arvense*, or Canada thistle; in which plant raphides are formed in the flower receptacle and also in the parts of the flower, also some other crystals which seemed to have four faces tapering to a point at each end (crystal prisms). The number of faces were probably double this. These crystals were soluble, with effervescence in hydrochloric and not in acetic acid. The raphides gave the chemical test for phosphate.

In *Cirsium muticum*, or swamp thistle, the crystals of inuline were very small and indistinct. The raphides were found the same as in the last species, though more numerous. The crystal prisms I was not able to find at all, the reason perhaps is, that I had only a young plant, while of the Canada thistle I had a fall or late specimen. *Cirsium lanceolatum* gave the same results as *C. arvense*.

In *Cynthia virginica* raphides of small size but no inuline were found. There were also a few cubical crystals in the lower part of the stem and in the flower receptacle, which gave answer to the test for carbonic acid with acetic acid, but the raphides proved to be phosphate. The cubical crystals were about the $\frac{1}{3000}$th of an inch in diameter.

Senecio aureus and *S. balsamitæ*[1] contained acicular crystals which, upon chemical examination, gave evidence of oxalate of lime. In this genus I was not able to find any raphides at all, nor any inuline. A few crystals were present, but on account of their small size and number, I was neither able to determine their form nor chemical nature.

Lappa major, or common burdock, contained in the flower receptacle and dried fruit, minute cubical crystals, which gave the tests for carbonate of lime. No raphides or acicular crystals of any sort were present.

Tanacetum vulgare contained both cubical and acicular crystals, the latter in the leaves and petiole, and the former in the flower parts; and upper part of the stem; both oxalate and carbonate of lime seemed to be present.

The raphides of this order seem to be rarer in the division or sub-order Liguliforæ, while the acicular crystals or crystal prisms were only found in the sub-order Tubulifloræ. Inuline is common to both sub-orders.

It will be seen on reference to my work that the raphides seemed to be composed of phosphate of lime, the acicular or crystal prisms, of oxalate, and the cubical crystals, of carbonate of the same, while the sphæraphides seemed to be the same base combined with different acids according to their locality.

It will be remembered that in the first part of this paper I mentioned the fact that crystals of some form were nearly if not quite universal, and as some slight evidence of this I have compiled with care a list of all the families in which crystals have been reported. This is the beginning of a more complete list of the genera and species which I hope soon to have ready for publication, which will be classified according to the kind of crystals that the species may contain.

[1] A variety of *S. aureus*.

The following is the list of families:

CRYPTOGAMIA.

[1] Filices
Equisetaceæ
Hepaticæ
Characeæ
Musci
Algæ
Fungi.

PHÆNOGAMIA.

EXOGENÆ.

Araliaceæ
Aurantiaceæ
Balsaminaceæ
Berberidaceæ
Cactaceæ
Camelliaceæ
Caprifoliaceæ
Caryophyllaceæ
Chenopodiaceæ
Cinchonaceæ
Compositæ
Coniferæ
Crassulaceæ
Cruciferæ
Cycadaceæ
Droseraceæ
Elæagnaceæ
Euphorbiaceæ
Ficoideæ
Fumariaceæ
Galacineæ
Geraniaceæ
Galiaceæ
Halorageæ
Juglandaceæ
Leguminoseæ
Linaceæ
Melastomaceæ
Nyctaginaceæ
Oleaceæ
Onagraceæ
Orobanchaceæ
Oxalidaceæ
Passifloraceæ
Phytolaccaceæ
Polygonaceæ
Pittosporaceæ
Rubiaceæ
Saxifragaceæ
Scrophulariaceæ (Gelsemineæ.
Tetragonieæ
Tiliaceæ
Urticaceæ
Valerianaceæ
Vitaceæ
Zygophyllaceæ.

ENDOGENÆ.

Amaryllidaceæ
Araceæ
Bromeliaceæ
Burmanniaceæ
Butomaceæ
Cyperaceæ
Dioscoreaceæ
[2] *Gramineæ*
Hæmodoraceæ
Hypoxidaceæ
Iridaceæ
Juncaceæ
Liliaceæ
Linaceæ
Marantaceæ
Melanthaceæ
Musaceæ
Orchidaceæ
Orontiaceæ
Pandanaceæ
Pontederiaceæ
Smilacaceæ
Typhaceæ
Xyridaceæ
Zingiberaceæ.

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[1] In this family I have seen crystals but once, and these were contained in *Phegopteris hexagonoptera.*

[2] The crystals of this family were shown to me by a fellow student in the University, Ann Arbor, Mich.

The names that are in italics indicate the families in which I have seen and studied the crystals, but only in a few cases their chemical composition.

Some of these, as the Onagraceæ and Orchidaceæ, contain large and beautiful crystals. In the vanilla bean, which is a fruit belonging to a species of the latter family, T. F. Meyer, of the university class of '78, has reported and made drawings of the crystals. He states that they are composed of the active principle of the bean and belong to the second class or crystal prisms.

It is often supposed that minute substances have no particular use, and so it may be thought of these minute crystalline bodies; but generally anything that occurs in such abundance and so regularly has some use in the economy of either the animal or vegetable kingdom. On the use of the crystals Prof. Gulliver says: "Although the precise use of crystals in the vegetable economy may be obscure, it is plain that whatever is constant in the plant must be important, and by no means necessarily of little importance because of such obscurity." Taking, for example, the Cactus family, which abounds in large crystals, some specimens of which have been reported to contain so many of these minute inorganic bodies that it was almost impossible to move the plant without breaking it, and when moved it was necessary to pack it in cotton with great care, as if it were the finest jewelry. A case like this is seldom met with, but as the occurrence of crystals is so constant a feature of this family, they must be of some use, which is, as yet, beyond the reach of man's power to perceive, and it would seem ridiculous to say that they have no use as some prominent scientific gentlemen claim.

But such crystals may be of use to man, perhaps in two ways; first, when contained in some medicine.

It is well known that the disease called "rickets" is treated, or at least has been, with sarsaparilla; now the plant itself contains a large number of crystals which are composed of phosphate of lime. Query—why may not this plant, in connection with its tonic effects, also furnish some of the needed phosphate to strengthen the bones?

Second, they may be of use to man when contained in decaying leaves or plants, thus acting as a fertilizer.

Again, crystals are sometimes used by the merchant as a test for the genuineness of a drug. The quality of rhubarb is often

tested by its grittiness, which is due to inorganic crystals, and rhubarb should contain a high per cent. of inorganic matter.

Other uses might be enumerated and given in this list, and perhaps some of them are of more importance than those mentioned, but sufficient has been said to show that they are probably of some practical value to man. It is hoped that this article will induce other investigators to take up this subject and find, if possible, their exact use in the economy of the plant.

The time is probably not far distant when we will know more about microscopical crystals in plants, and for that time we must all wait, each investigator endeavoring to do his best.

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ON THE ORIGIN OF THE LAC.[1]

BY J. M. STILLMAN.

DURING the course of an examination of a product from Arizona, apparently identical with the gum-lac from India, I had occasion to consult various works touching on the origin of this interesting product.

The statements met with were in many cases contradictory, and the most usual statement so directly opposed to what appears to me, from a careful examination of the deposit and of the evidence on the subject, to be the truth, that I cannot refrain from at least suggesting what seems to me to be the true state of affairs. At the same time I wish to state, that as far as the lac insect is concerned, I have not been able to find sufficient data regarding its anatomy and life-history to enable me to touch upon some very interesting points in connection with the subject. Nor am I cer-

[1] This paper was read before the California Academy of Sciences, April 19, 1880.

tain that the questions here considered have not been thoroughly discussed by previous investigators, but if so, the current chemical literature, encyclopædias and some of the natural history treatises have overlooked such work, so that there has crept into the literature a statement with regard to the origin of the gum-lac which I think is an incorrect one. This is, that the gum-lac is an *exudation* caused by the puncture of the lac insect *(Coccus lacca)*.

This is stated in such standard works as "Muspratt's Chemistry" (even in the late German edition), Wurtz's "Dictionnaire de Chimie," "Johnson's Encyclopædia," &c., and in various text-books on chemistry, and various works on natural history accessible to me. "Chamber's Encyclopædia also asserts the same fact by saying that the insects "entomb themselves in a mass of matter which oozes from small punctures made in the twigs of the tree," but also adds, "As we have no strictly analogous resin from the vegetable kingdom, *not even from* the lac-bearing trees, it may be assumed that the *juices of the trees* are somewhat altered by the insects."

Watt's "Dictionary of Chemistry," on the other hand, says: "Lac is the product of the *Coccus lacca*, which deposits its eggs on the branches of a tree called Bihar in Assam and other parts of India. It appears designed to answer the purpose of defending the eggs from injury and affording food for the maggots in a more advanced state. It is formed into cells finished with as much art and regularity as in the honey-comb, but differently arranged."

This statement is not to be accepted entirely, I think, but in so far as it states that the lac is the product of the insect rather than of the tree, I think it is correct, and it is this thesis that I wish here to maintain.

Let me first state briefly all that I feel confident of regarding the life-history of the *Coccus lacca* of India. The lac insect, like many other insects of its kind, lives and dies in the same spot. The young insect, after emerging from its hatching place in the body of the mother, crawls off as an extremely minute bug of a bright red color. It very soon attaches itself to the branch, loses its legs, antennæ, &c., its sides expand [illegible]ed to the branch like a minute scale bug. He[illegible] the juices of the twig which it suc[illegible]

the bark. If it be a female, and I shall take cognizance here only of the female insect, as it grows older it forms its eggs, and the entire insect develops into a shapeless sac enveloping these eggs. Within this sac is developed at the same time a purple-red gelatinous mass which contains the eggs and perhaps serves as food for the young insects. By this time, also, the numerous sacs are entirely enveloped in a heavy mass of the lac-resin. The cellular structure of the latter is caused by the soft sacs of the females enclosed in the hard resin. When the young are hatched, they bore a hole through the back of the mother-sac and through the resinous envelope and escape, fix themselves to new portions of the plant and the life-history begins again.

Now, although I am by no means confident that the Coccus which forms our Arizona lac is identical with the *Coccus lacca*, yet I think that I can show that the resemblance is sufficiently close to enable a course of reasoning on this insect to apply to the Indian species as well. In the first place the very great chemical similarity of the Arizona gum to the Indian, as shown at a meeting of the California Academy, is a presumption to this effect. In the next place, the coarse cellular structure of the resin, the enclosed sacs with the eggs and purple juice, formed in the Arizona product and agreeing with the descriptions of the India lac, are another set of facts strongly confirmatory. Lastly, the specimens of lac from Arizona with the holes bored in it by the escaping insects, furnish additional evidence of close agreement. Very recently also I have received from Mr. J. A. Culbertson, of Arizona, specimens of the young insects affixed to the twigs. They are minute scale-bugs of a red color, with indistinct markings across the back. In size I should roughly estimate them at one-fiftieth of an inch in length and half that in width, though some are even smaller. No doubt could exist but that they belong to the Coccidæ, and that they are very similar in development and life-history to the *Coccus lacca*. Hence I think that any general deductions from examination of the Arizona lac will apply equally well to the India product, especially as all descriptions of the products of the insect—lac-dye and lac-resin—seem to coincide.

We notice first that resin is developed only by the action of this insect. No similar product can be obtained from the plant by other means. This is stated of the India lac in the sentence

above quoted from "Chambers' Encyclopædia." Eye-witnesses say, that the Arizona lac also does not occur wherever the plant, upon which it grows, is found, but only in particular regions or patches. In the second place the gum-lac of India occurs on no less than five trees, *Ficus religiosa*, *Ficus indica*, *Rhamnus jujuba*, *Croton lacciferum*, *Butea frondosa*, and that from Arizona on two plants, the *Larrea mexicana* and *Acacia greggi.* These plants are not related for the most part, and do not afford the gum except under the influence of the insect.

In explanation of these facts we have two alternatives to choose from. First, the gum is an exudation from the twig, excited by the puncture of the Coccus; it flows out, envelops the insects, hardens and forms the gum-lacs; or, second, *that the gum is the elaboration of the insect itself.*

The first explanation is the one usually given, the second one appears to me the true one, and the following facts and considerations appear to me to sustain this view:

1. The gum-lac is not simple, like most vegetable resins, but is composed of resins soluble in alcohol, wax and gluten, or substances resembling gluten. Such a complex substance might be expected from an animal secretion.

2. The resin, as far as known, possesses the same general composition and properties independent of the species of plant, whence it is derived, since no specific difference is given for any of the seven India varieties, and the two Arizona sorts have probably the same general composition. The kind of plant and the character of its juices undoubtedly have a general influence, inasmuch as the sap of some plants would not support the life of the insect nor furnish it its necessary materials for the elaboration of its products.

3. If the resin were an exudation from the plant, simply induced by the puncture, we should expect to find this resin more or less collected into globules, drops, or masses independent of the immediate presence of the insect. In my examination I could find no particle of resin which did not form a bounding wall to one or more of these cells occupied by the egg-sacs.

The only places, where the resin anpeared solid and thick, was in the spaces between three or more contiguous cells, as if the sacs had, by their united secretions, filled up the small room between them. In some specimens what appeared to be a small

drop of resin on the bark, where a small insect had covered its dome-shaped body with a layer of resin, was as thin-walled as the shell of a mustard seed. In such a case we are called upon to suppose that a flow of resinous juices starts from below the insect, passes up over its body and nowhere else, and covers it with an even layer of resin. This is to me a difficult conception. On the other hand, it is easy to conceive how the insect simply feeding on the juices from below, and secreting this resinous substance from its body, could build such a shell of resin.

4. By careful examination of bark and wood, no puncture or abrasion could be detected at all adequate to account for such a *spontaneous flow* of the sap of the plant, as would produce the amount of resin present. This examination was repeated with the assistance of Prof. Joseph Le Conte, who concurred fully in the conclusion arrived at.

All these facts, so inexplicable on the exudation theory, appear to me to be readily explained on the basis of the insect origin of the gum. The insect fixes itself to a spot on the bark where it lives and dies. For its sustenance it is dependent on the sap of the plant. Certain plants are adapted to this purpose, others are not. The juices sucked up and absorbed by the insect serve as its food, and at the same time as material, from which is elaborated the resinous envelope, destined to serve as a protection for the eggs and larvæ. This resinous substance may be exuded from the entire surface of the insect, or from particular organs or glands; I am in no position to pursue this point, interesting as it is. This elaboration thickens as the insect grows older, and as the insects live in close proximity they become crowded and distorted, and the spaces between them compactly filled with their united elaborations, so that the result is as we see it, a resinous mass of coarse, irregular, cellular structure, with the egg-sac filling the cell, or, after the specimen is dried or the young escaped, with the shrunken remains of sac and eggs in the cell.

This explains the occurrence of practically the same resin on various plants—the form and structure of the resin—that it surrounds the sacs on all sides perfectly, but does not run off along the bark of the twig nor collect into solid drops or masses—a fact difficult to explain on the simple exudation theory. It also gives a definite meaning to the "alteration" of the juice by the insect referred to in "Chambers' Encyclopædia."

Whether the lac is to be considered as an excretion or secretion is very much a matter of definition. If by secretion we mean a definite substance elaborated by the organism for a definite purpose, this would appear to be a true secretion. On the other hand, once secreted it probably exerts no further internal function in the organism, and is in so far an excretion. In the same sense, hair, nails, epidermis, etc., continually discarded by the organism, might be considered excretions. However we may regard it, it is probably a normal product of the vital activity of the lac insect.

A somewhat striking objection against this theory is, that it is against analogy, that a well-marked resin should be the product of animal life. But so also is the production of *wax* by the bee against the same analogy, and yet it has been proven that bees confined to an exclusive diet of sugar will produce wax formed by their own vital processes, and any philosophical distinction between *wax* and *resin* in *this* particular would, I think, be difficult to establish.

In conclusion, I would again reiterate that I am by no means certain that the question of the origin of the lac has not been settled by observers more directly interested in natural history, but if so, our chemists and encyclopædists have been slow to find out the facts, and our most recent authorities, with few exceptions, adhere to the exudation theory. If this communication has the effect of bringing to notice previous work, or gives rise to more complete investigations in the future, it will be as much as I can expect from it.

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BOTANIZING ON THE COLORADO DESERT.

BY EDWARD LEE GREENE.

I.

IN February of 1877, by way of the stage road between San Diego and Fort Yuma, I made a little expedition across the interesting region above named. A desert is not naturally supposed to be the most eligible locality, nor midwinter the best season for making botanical excursions, yet seldom has a week's recreation of that kind given me more satisfaction than that upon which I have preserved the following notes:

In passing from west to east across Southern California, the

first glimpse one gets of the desert is a fine bird's-eye view. From the San Diego plains, all treeless, brown and dusty, an easy two days' journey brings the traveler up to the level of that broad plateau which constitutes the summit of the coast range. Across this forty-five miles of mountain top, one travels pleasantly; now through handsome groves of evergreen oaks, then among a succession of low, rounded, stony hills, between which some bits of fresh, green mountain pasture spread themselves; here passing a settler's cabin with its newly ploughed fields and its group of blooming peach trees, and there meeting a merry, boisterous gang of mountain herdsmen. Having thus come to the eastern verge of the plateau, the great wilderness breaks all at once upon the view, beginning a dizzy half mile down beneath your feet, and stretching away to the eastward for a hundred miles. It was past the middle of the afternoon when I reached this interesting point, and paused to rest a while and to enjoy the novel scene, so desolately grand, which lay before me. The region in question is far from being a flat monotonous expanse of naked sands.

Its general level is broken by many abruptly rising knobs and peaks and by several prolonged chains of high and sharply defined rocky hills, all lifting themselves up like precipitous islands above the even surface of a sea; and although these peaks and ranges are destitute of verdure, and red as the sands that drift about their bases, they yet combine to make a most impressive picture when viewed at a distance, and from this aerial elevation where the desert first appears in sight. Aware that the stage station where I must pass the night was not more than two miles away by the steep, winding road, I lingered here until the sun was near his setting, and the shadows of the peaks and pyramids I sat among, were measuring their dark lengths upon the plain afar below, and the purple evening clouds had reflected their own almost gorgeous coloring to the vast, varied landscape that stretched eastward and northward so very far away. This strange sunset scene was beautiful beyond all description, and will be treasured for a lifetime in the beholder's memory.

Having descended from these picturesque heights, it was nearly dark when, as the road led around a sharp angle of the mountain, I found myself almost at the door of the stage company's little hotel. Here were pleasant sounds; the music of water trickling

down through an iron pipe from a small spring that rises among rocks which almost overhang the house hundreds of feet above; and by the way, the sound of running water is never so musical as when one has traveled six hours in torrid heat without having tasted a drop. Music also of insects was here, evidently some sort of bees which, even in the late twilight, were humming amid the rosy, flower-laden boughs of the desert almond. This handsome bush (*Prunus andersonii* Gray). when in flower, resembling a small peach tree, contrasts very prettily with its associates, the cacti and agaves which thrust forth their clumsy, graceless forms from every niche and crevice of this grand mass of rock which walls in the desert on the west. While most trees and bushes of that genus require good soil and a fair supply of moisture, this species appears to thrive, like the spiny cacti, on nothing more substantial than the sunburnt rocks and the desert air.

The condition in which I found the solitary tenant of this isolated hostelry illustrates one of many dangers to which the lone keepers of these desert stations are exposed. He was bending over a basin of water bathing his head and face, which parts, as I could see by what remained of daylight, were bleeding freely. He seemed in too much pain to notice the near approach of the stranger, at whose unexpected presence the man's sole household companion, a fierce bull-dog, tugged away at the end of the chain in a rage which I should not have smiled at had the chain been a light one. Presently, however, the man tied a bandage about his head, unbent himself, turned toward the door where I was standing, and I inquired what had befallen him. He replied that he had, a few moments previous to my coming, gathered himself up from the stable floor where he had been lying unconscious he hardly knew how long, having been kicked by a vicious stage horse left in his keeping. Luckily for him and somewhat so for me, tired and hungry as I was, the wound was not serious. He was an intelligent youth, intelligent enough to comprehend my reason for undertaking a walk across the desert. Under his cabin roof I fared well, and on the hardest of beds enjoyed such sound, refreshing sleep as is given to tired but happy travelers.

From this hostelry among the cliffs, a few minutes' morning walk brought me to where the mountain flanks are parted by a deep gorge indicating where, in times long past, a river made its way from the highlands down to the sea which then occupied the

area now a desert. The road here descends to the dry bed of the extinct river, and follows it directly to the plain. The grade is easy but the loose white sand is deep, and in this sandy rock-walled passage I met two Indians, a man and woman, whose decrepid forms, withered features and whitened hair made them look almost prehistoric, toiling upward on foot, each with a heavy pack of blankets and pottery on their backs, while a few rods behind them a stalwart youth of about thirty years rode in serenest laziness a half-starved looking pony. It was probably another party of herborizers this, on their way up to the rocky heights where the wild maguey plants grow, to feast on the tenderly springing flower-stalks, and make mezcal.

February days in this region are nearly as warm as days of July in New England, and as I walked along the south wall of the cañon, gratefully sheltered from the heat of the morning sun, I easily comprehended the origin of that oriental phrase: "The shadow of a great rock in a weary land." Here at my feet, where the sand was shaded, grew and bloomed a low spreading variety of evening primrose (Œnothera), with large, pale yellow flowers. On the opposite side, more exposed to the sun, the whole base line of the rising cliffs was ornamented with a continuous hedge-row of a very handsome shrub (*Hyptis albida* H. B. K.) with whitish foliage, its branchlets ending in slender spikes of fine, deep purple flowers. The desert shrubs, however brilliant their flowers may be, are usually without much show of foliage, most of them bearing spines or briers instead of leaves.

But besides this pretty, white-leaved Hyptis, I noticed one other exception to that rule in the case of a smaller bush (*Beloperone californica* Gray), the stems of which were buried half their length in the drifting sands, and whose salvia-like spikes of scarlet flowers were subtended by neat foliage of a bright shining green. From admiring these first beauties of the desert, my attention was next drawn to a tuft of tall, slender, reed-like stems with pale-green bark which, though appearing wholly leafless, produced at their summits several pendant clusters of white flowers. At a few rods distance one would never have guessed this graceful plant to be a near relative of the stout coarse leaved silk-weed of Eastern fields and waysides; but a glance at the structure of the flower showed the plant to be a genuine Asclepias (*A. subulata* Dec.). The stems, though altogether smooth

and reed-like as seen at a distance, show distinctly, to the nearer view, the nodes at which, in other species of the genus, broad, flaunting leaves are developed, and at each of these leaf-nodes the careful observer detects a pair of minute, awl-shaped appendages which are technically the leaves of this anomalous Asclepiad of the desert.

On passing forth from the mountain gorge to the open plain, the eye is greeted by an assemblage of such strange-looking vegetable forms as command the wondering attention of all travelers, whether scientists or not. Among these the cacti are the most conspicuous; some of them globose or cylindrical, resembling so many enormous melons set up on end, having prickly sides and bearing flowers and fruits at the top. Others are more like orchard trees, with smoothish trunks and well-rounded heads of branches bending under a load of pear-shaped fruits.

One of these cacti (*Opuntia bigelowii* Engelm.) is, in its general aspect, doubtless a more forbidding thing than any "thorn" or "thistle" which the ancestral fugitives from Eden ever met with in oriental wilds. If the reader wishes to form a definite and tolerably correct idea of this plant's appearance, let him imagine a post four or five feet high and as many inches thick, putting forth, from its upper extremity, a half dozen clumsy arms or branches of the size and shape of ordinary ball-clubs, the trunk and club-shaped branches all so thickly beset with long, needle-like, glistening spines, that the spines are actually the only part of the plant visible. With such a horrid growth as this the grand knolls and lower slopes of all the hills are covered.

Extremely odd looking and not more odd than beautiful is the small tree locally known by its Mexican name ocotilla (*Fouquiera splendens* Engelm.). It grows to the height of from eight to twelve feet, and in outline is quite precisely fan-shaped. To show how this may be, let me describe more particularly its mode of growth. The proper trunk, usually ten or twelve inches in diameter, is not more than a foot and a-half high. At just a few inches above the surface of the sands this trunk abruptly separates into a dozen or more distinct and almost branchless stems. These simple stems rising to the height of eight or ten feet, gradually diverge from one another, giving to the whole shrub the outline of a spread fan. Each separate stem is clothed throughout with short gray thorns and small dark-green leaves,

and terminates in a spike a foot long of bright-scarlet, trumpet-shaped flowers. This splendid oddity flourishes in great abundance in many places.

The stems are not so thickly armed with thorns but that a man may handle them if he will seize them circumspectly with his fingers, and being very hard and durable, as well as of a convenient size, they are much employed for fencing purposes about the stage stations and upon the ranches adjoining the desert. Give a skillful Mexican ocotilla poles and plenty of raw hide thongs, and he requires neither nail nor hammer to construct a line of fence which for combined strength, neatness and durability fairly rivals the best work of that kind done in our land of saw mills and nail factories. As a tree or shrub of strange peculiar beauty, the cultivators will vainly desire to add this to their list of varieties, unless their art can reproduce the parched and sterile gravel heaps and the dry, withering atmosphere which it finds congenial. Those who have ever experienced anything of a naturalist's enthusiasm will readily believe that the writer, in passing amid these and other unmentioned objects of thrilling interest, hardly felt the intensity of the mid-day heat, nor realized how much he was suffering from thirst until, at two o'clock, almost before he had thought of such a place or wished it near, he found himself but a few rods away from the station of Coyote Wells. This is the westernmost stopping place on the desert, only twelve miles out from the base of the mountains. The place derives its name from the fact that here the Coyotes, long before ever white men had passed this way, smelled water near the surface, and pawed in the sands until they reached it. These wells of the Coyotes having been suitably excavated and curbed up, supply the best water that has been found on all the breadth of the desert; the other wells being more or less strongly impregnated with offensive salts or alkalies. Having reached the shade of an adobe wall, I gladly took refuge from the heat, and for something less than an hour, did little but drink water. Dinner was then announced, after which I sought again the shade outside, rested, and studied for another hour the rugged outline of a mountain range which broke the level of the plain some ten miles to the northward. The station keeper was going to remove thither some day to settle and dig gold; plenty of the precious metal there; no doubt about it. Only a few years ago a white man and a negro had gone there to dwell to-

gether and amass each his fortune. A late party of prospectors passing that way had found the white man's bones whitening among the sun-burnt rocks. The conclusion was that the negro had murdered his partner and absconded with the accumulated gains of both. And with many such cheerful and edifying bits of history do they seek to beguile the time which weary travelers spend at these desolate halting places in the wilderness.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— Whenever an institution accepts a bequest designed to assist impecunious but worthy students in the acquisition of some useful kind of knowledge, such as natural history, its obligations to itself, the donor and beneficiaries of the gift, are plainly that it must, under the direction of a competent committee, see that the donated funds are applied to the objects for which they were given. Such bequests render the institutions accepting them, *charitable*, and if in addition the bequest is for the purpose of enabling any particular class of persons to acquire a specific kind of knowledge, the institution becomes *educational* in the same sense that any special school is considered to be such. Under no ordinary circumstances can the governing body in charge of such a trust, neglect the duty of ascertaining whether the persons directly in charge of the incumbent beneficiaries, do their duty, and whether the beneficiaries themselves are competent persons who are making the proper progress under the proper discipline. Otherwise there is room for maladministration under unauthorized authority; or, the beneficiaries with no direction, under no discipline or instruction, fritter away their time in fruitless effort, at a period of life when they can ill afford to lose it.

The Academy of Natural Sciences, of Philadelphia, some years ago accepted a trust of this kind. Mr. A. E. Jessup's children, out of dutiful regard for their father's wishes, gave the society a sum in trust, the income of which was designed for the benefit of impecunious young men who desired to devote the whole of their time and energies to the pursuit of natural science. The desire to give a sum of money for such a purpose in a man like Mr. Jessup was a natural one, which probably took its rise in the recollection

of his own early struggles for knowledge, when he, too, was poor. He wished that the money he had verbally bequeathed should be used for the support of *poor* young men only, who would devote the *whole* of their time to study. Have Mr. Jessup's wishes been fully complied with in the administration of the benefits of the fund?

It has been argued that inasmuch as the Academy afforded the facilities for study in its library and collections, that all Jessup beneficiaries should in return spend a certain number of hours each day at work for the Academy. This is now the rule. But, as it has been claimed time and time again that the Academy is a charitable institution, it does not seem to be in keeping with this claim to ask Jessup scholars to devote a part of their time to labor in order to pay the Academy for the privilege of studying in its building, especially when the work they are frequently expected to perform has no interest to them or no scientific bearing whatever. The character of some of the work at which Jessup scholars have been employed, may be gathered from the following statements of facts: In one case a beneficiary was put to washing shells to prepare them for a specialist; another was employed at brushing and dusting off the collection of stuffed birds; on another occasion one of them was set to work by the librarian to copy the titles of books in the library for compilation of catalogues, properly the duty of the librarian himself, for which he is employed and paid. It has become the rule to make the Jessup scholars take the place of the janitors at the door once or twice a week, to sell the tickets which admit strangers to the museum of the Academy. It is hard to make a mental distinction in these cases between the supposed duties of a janitor and a Jessup scholar of the Academy. For months at a time Jessup scholars were employed in packing, hoisting, moving and unpacking cases, specimens, books and lumber during the time when the library and museum were being removed to the new building, in company with other laborers, yet it was considered that this was a part of the curriculum of study for which they could properly receive pay from the Jessup fund. The president of the Academy has had his official correspondence copied in duplicate by a Jessup scholar on various occasions. Besides these abuses, the recording secretary was in the habit of having his weekly reports of the meetings of the Academy copied in duplicate by one of them for the daily press, and the corresponding secretary has the blanks acknowledging donations filled up by one of these scholars. They are also frequently used as messengers by the secretary, president and curators. They have become, in short, a species of men-of-all-work, useful to everybody about the institution, with no definite knowledge of their relation to the fund from whence they derive an income just sufficient, with close economy, to support themselves. These persons then are virtually employés of

the Academy, paid from the income of a bequest designed to foster free scholarships. Suppose the various scholarships in America and the fellowships in English universities were tenable only upon condition that a certain amount of manual labor was performed; would it be at all likely that Prof. Clerk-Maxwells or Sir Wm. Thomsons would be the results of the system?

A matter which also deserves notice is the custom of assigning to Jessup students the work of arranging and labeling the collections of which they possess no previous knowledge. This plan is in principle beneficial to the student, and its originators rightly comprehended the benefits to be derived from a systematic study of any given group of animals. But it is obviously improper to entrust the determination of a collection for scientific study to inexperienced persons, who are, moreover, sometimes careless, or quite indifferent about the accuracy of determinations. This plan is also objectionable on account of the fact that the training of a young naturalist in this way restricts him to a comparatively small group, so that he is quite unfitted to begin work as a teacher from a lack of comprehensiveness and the originality consequent upon a system of more general work. A broader preliminary training should be required of a person who applies for the benefits of this fund, all of which would redound to the credit of both the individual scholars and the Academy in after years. His knowledge of the elements of biological science should be as full as possible, so that he would not be afterwards compelled to go back and begin at the ground principles of his science, in order to underpin, as it were, his own mental superstructure.

In order to realize the abolition of what is manifestly wrong, as indicated in the foregoing recital, it is much to be desired that a living interest should be taken in the welfare of the Jessup scholars and scholarships, by members of the Academy, who by reason of their scientific attainments and experience as educators are abundantly able to do so. The apathy which allows the present condition to continue, is wrong, because the opportunities for the nurture of young men, who may become eminent naturalists, in the Academy might be made as good as anywhere in the United States. It remains the duty of the governing body of the Academy to appoint some naturalist who shall see that some sort of plan of study is followed by each student, and define and plan some specific courses of preliminary training in biology which would qualify the student to begin independent and original studies for himself, in which he might distinguish himself and reflect credit upon the institution which fostered him. The realization of some such method of training could readily be effected by the adoption of the scheme of professorships or curatorships which has elicited such an amount of silly animosity.

RECENT LITERATURE.

Bessey's Botany.[1]— To one who is desirous of obtaining a knowledge of general botany we should unhesitatingly recommend this manual. Most of the botanies which the student deals with are manuals of the flowering plants, rather than of plants in general, and thus he is led to believe that there are few plants in the world besides the flowering ones, that what do exist are of little importance, and thus his idea of the plant world is a limited and one-sided one; and by plant we mean not a phanerogam or cryptogram, but a plant as distinguished from an animal. In the same way many of our manuals of zoölogy are treatises on the vertebrated animals rather than on animals in general. It is true that in order to teach the elements of botany to beginners it is better to give them a general idea of the structure, physiology and mode of development of a common, well-known and accessible flower or tree; but if the study of botany is to be made a discipline, if the student is required to acquire a good general knowledge of the plant world—and our college students should be required to attain such knowledge—he must, after acquiring a good general knowledge of a few common flowers, master the kind and extent of knowledge contained in a book like the one before us. In short, he should study with the aid of some such book as this the types of the leading divisions of plants, beginning with the Protophytes and ending with the algæ, mosses, ferns and flowering plants, or at least, if the pupil is not carried so far in his studies, the teacher should be armed at all points in his knowledge of general botany, so that he may rightly inform the pupil regarding the structure and physiology of the lower plants, for the sake of bringing out more clearly the position in nature and general relations to other organized beings of the flowering plants.

While, therefore, this book is designed apparently for advanced classes, it will be of especial value to the thousands of teachers of botany in the higher schools scattered over the country. Without disparaging school books written by other botanists, it seems to us that Prof. Bessey's book is indispensable to the teacher of botany as it is or should be taught in these days in our leading colleges and universities.

It moreover derives its value in large part from being compiled from the works of Sachs, De Bary, Hofmeister, Strasburger, Nägeli, Schwendener and others; the first part following quite closely Sachs' botany, many of the admirable cuts in that book being reproduced, so that those who cannot obtain the more costly and voluminous work of Sachs can master this book.

The volume is divided into two parts; the first consists of

[1] *Botany for High Schools and Colleges.* By Charles E. Bessey. American Science Series. New York, Henry Holt & Co., 1880. 8vo, pp. 611. $2.50.

twelve chapters on the following subjects: protoplasm, the plant cell, the cell wall, the formation of new cells, the products of the cell, the tissues, the tissue systems, intercellular spaces and secretion reservoirs, the plant body, the chemical constituents of plants, the chemical processes in the plant, and twelfth and lastly, the relations of plants to external agents. We have read most of this part with much interest, and do not know of a briefer, clearer and better illustrated exposition of the subjects treated. It is well adapted to give one who has but little special knowledge of botany a clear conception of the plant as an organism. A good many technical names are used, and an elementary knowledge of botany is required of the student, so that while we doubt whether high school classes are sufficiently advanced to use the book, the teachers of such classes should master this portion and present it in as simple language as possible to their pupils.

The second part occupies the last four hundred pages of the book, and is entitled, Special Anatomy and Physiology. It treats of the general classification of plants. The arrangement of the lower plants is a modification of the system of Sachs, while the author has made a considerable innovation in raising the Protophyta, Zygosporeæ, Oösporeæ and Carposporeæ to the dignity of primary divisions of the vegetable kingdoms, of the same rank as the Bryophyta, Pteridophyta and Phanerogamia. This part contains brief general descriptions of the cohorts, orders and tribes of plants, with sufficient reference to economic botany.

The illustrations are excellent and abundant, there being five hundred and seventy-three cuts scattered through the volume, a large number taken from Sachs' Botany, from De Bary, Hofmeister and other German, French and English works, while a number are original, having been drawn by Mr. J. C. Arthur.

The work bears evidence of care and accuracy in its preparation, and while we have borne testimony to the general plan and its treatment, we leave to others the task of detecting and noticing the errors and shortcomings, if such occur.

HUXLEY'S INTRODUCTORY TO SCIENCE PRIMERS.[1]—Every incipient biologist or geologist should study this little primer, which will serve admirably its purpose as a brief and plain introduction to the study of nature. It is well calculated to be used as a text book for classes in elementary biology or geology, and we intend to use it as a basis for preliminary instruction to a course of physical geography. Beginning with nature and science it treats of sensation and things, causes and effects, the order of nature, laws of nature, and gives a definition of science. A second part discusses material objects, which are divided (A) into mineral bodies,

[1] *Science Primers.* Edited by Profs. HUXLEY, ROSCOE and BALFOUR STEWART. Introductory. By Prof. HUXLEY, F.R.S. New York, D. Appleton & Co., 1880. 18mo, pp. 94. 35 cents.

water being the mineral chiefly referred to for the sake of illustration, and (B) living bodies. Under the latter head the wheat plant and the substances of which it is composed, the common fowl and the substances of which it is composed, are described in the compass of three pages; then the constituents of the body common to the wheat plant and the fowl. What is meant by the word living, and how the living plant comports itself, and how the living animal grows, and how living bodies differ from mineral bodies is told in a few clear, simple sentences. Finally the science of biology and its subdivisions, botany and zoölogy, are defined, and a final page or two is devoted to mental phenomena and the definition of psychology.

EMERTON'S SEASIDE COLLECTING.[1]—In England and France popular works on the animals of the seashore, and the names of Gosse, Forbes, Kingsley and Quatrefages are associated with some of the most entertaining books that have ever been written. America, on the other hand, has been wofully deficient in works of this character. The only ones which approach it being Mrs. Agassiz's Seaside Studies, Verrill and Smith's Invertebrata of Vineyard sound, and the charming little work of "Actæa." In the present volume Mr. Emerton has given us a well illustrated account of the common marine forms of invertebrates with the methods of collecting them. The work is written in Mr. Emerton's straightforward manner, and from a literary point of view is superior to his well-known volume on spiders. A fair proportion of the 161 figures which illustrate the book are new, while the remainder have not been copied often enough to render them at all hackneyed. The pictures of *Lophothuria fabricii* and *Pentacta frondosa* are possibly the best. Here we would remark that the genera Callinectes, Lophothuria and Leptosynapta seem founded on decidedly insufficient grounds, and should be replaced by Neptunus, Peolus and Synapta. The book is well printed on good paper and forms a very handy volume for all seaside visitors, and would prove especially valuable to the many who throng our watering places and who wish to know something of marine life.

It might not come amiss to add here that this is the first volume published by Mr. Bates, the successor to Mr. Cassino in the Naturalist's Bureau at Salem, Mass, and that it reflects great credit on the publisher.—*J. S. K.*

ZITTEL'S PALÆONTOLOGY.[2]—The third part of Vol. I of this important work especially commends itself to American palæontologists, since it continues and completes the elaborate account of

[1] *Life on the Seashore, or Animals of our Coasts and Bays.* By JAMES H. EMERTON. 8vo, pp. XX and 143. Salem, George A. Bates, 1880.

[2] *Handbuch der Palæontology.* Unter mitwirkung von W. PH. SCHIMPER. Herausgegeben von Karl A. Zittel. I Band, III Lieferung, mit 195 original holzschnitten. München, 1879, 8vo.

fossil Echinoderms begun in the preceding part, and is partially based on the researches in this country of Hall, Billings, Shumard, Meek and Worthen and Wachsmuth, so that while the work is mainly compiled from European works and museums, the fauna of the two hemispheres is nearly equally well described and illustrated. The Crinoids are treated with fullness, the descriptions of the families and genera being preceded by more detailed accounts of the orders, while the essential features of the class are given at greater length, due reference being made to the structure of the hard and soft parts of the existing species. The Cystoidea and Blastoidea have received full and detailed treatment. The starfishes and sea urchins are described in the same manner, nearly as much space being given to the sea urchins as to the Crinoids. This part is illustrated by about two hundred woodcuts, nearly all well drawn and engraved. We do not know of a hand-book which will, when finished, be so useful for reference as this, at least so far as concerns the invertebrated animals and plants.

KOPPEN'S INJURIOUS INSECTS OF RUSSIA.[1]—While the literature of economic entomology is fullest in this country, where more perhaps has been done than in Germany, France or England, considerable attention is now being given to this subject in Russia, which of late years, especially last year and this, has suffered grievously from the ravages of noxious insects. To the author of this book we are indebted for the best, most detailed and original treatise on the migratory locust of the old world.

After briefly enumerating the insects found on the more important trees and crops, the insects of different orders are described or referred to. The treatment of the subject is scarcely adapted to the needs of the unlearned, but as the first sketch of so vast a subject, the book will indirectly be of much practical value to Russian agriculturalists.

MISS OMEROD'S ENGLISH INJURIOUS INSECTS.[2]—Though this is a pamphlet of but forty-four pages, yet the eminently popular style and the illustrations will render it most useful to the average English farmer and gardener. Though British agriculturalists are heavy losers by the attacks of destructive insects, for many years past there has been a strange apathy on the part of the entomologists in calling attention to these pests. Miss Omerod's annual reports and her earnest labors in economic entomology will, it is to be hoped, awaken fresh attention to a subject which from its very nature has to be re-worked every few years. Miss Omerod announces her intention to prepare a hand-book of remedies to be used in checking the ravages of insects destructive to

[1] *Die Schädlichen Insekten Russlands.* Von F. T. KOPPEN. St. Petersburg, 1880. 8vo, pp. 526.

[2] *Notes of Observations of Injurious Insects.* Report 1879. London, W. Swan Sonnenschein & Allen. London, 1880. 1 shilling. 8vo, pp. 44, with cuts.

the food crops, timber and fruit trees of England, and she has therefore issued a circular asking information concerning the habits, appearance and remedies against noxious insects.

WHITE'S CONTRIBUTIONS TO PALÆONTOLOGY.[1]—These chapters contain descriptions of fossils discovered by the Hayden Survey, belonging to the Cretaceous, Tertiary, Laramie, Triassic, Carboniferous, Jurassic and again the Carboniferous formations of the Western Territories, in the order here named. The sudden, and as it has proved in many ways to be, disastrous abolishment by Congress of this great survey, has left no provision for the proper publication of the final results of the geological and palæontological work. But while the subjects treated of in these eight contributions have been thus presented in an unfinished state, opportunity has been taken to figure nearly every species described in the publications of the survey. Hence all that refers to the Tertiary, Cretaceous, Laramie and Jurassic invertebrates, as well as those of other formations, is rendered of much value in future researches in Utah, Wyoming and Idaho. Perhaps the most valuable of the contributions are Dr. White's descriptions of the Laramie invertebrates and his general introductory remarks. These afford materials for a monograph of the invertebrate animals of this interesting formation which it is to be hoped he may have the opportunity, by fresh field work, to complete.

THE ABORIGINES OF VICTORIA.[2]—This valuable publication was printed at the expense of the government of the province of Victoria in Southeastern Australia, and although it professes to sketch only the natives of the province aforesaid, we get from it a glance at all the Australian aborigines, their manners, customs, and racial peculiarities. The first volume enlarges upon the manner of sustenance, the education of children and the mental character of these natives; then follow sketches of their encampments and daily life, their diseases, their canoes, weapons and other implements. A chapter on pictorial representations drawn on pieces of bark will attract particular attention.

The second volume is devoted to the reproduction of numerous vocabularies and other linguistic material of the Victoria and Tasmania dialects, all of which seem to show considerable affinity and are, in part, of a very harmonious, or at least vocalic character; follows a series of appendices of ethnographic import: songs, music, sign-language, etc. Some of the songs are worded in th harmonious dialect of Kotúpna, at the junction of Goulbourn an Murray rivers. Among the myths, of which a large selection is

[1] *Contributions to Palæontology.* Nos. 2–8. By C. A. WHITE, M.D. U. S. Geological Survey, F. V. Hayden in charge. (Extracted from the Twelfth Annual Report of the Survey for the year 1878.) Washington, July, 1880. 8vo, pp. 171, 42 plates.

[2] *R. Brough Smith, the Aborigines of Victoria.* Melbourne, 1878. Two volumes in Lex.-octavo, profusely illustrated.

offered, those of the creator of all things, called *Pundjel* by the tribes of Bungwrong, Yarra, Melbourne, &c., are of peculiar interest.—*A. A. Gatschet.*

RECENT BOOKS AND PAMPHLETS.—The Foramina of Monro. By Burt G. Wilder. (From Boston Med. and Surg. Journ., Aug. 12, 1880.) pp. 8. From the author.

The two kinds of Vivisection—Sentisection and Callisection. By Burt G. Wilder. (From Med. Rec., Aug. 21, 1880.) pp. 2. From the author.

An address before the American Association for the Advancement of Science. By Alexander Aggassiz. pp. 26, 1880. From the author.

An address before the American Association for the Advancement of Science. By Asaph Hall. pp. 16, 1880. From the author.

The Classification of the Tertiary period by means of the Mammalia. By W. Boyd Dawkins. (From Quar. Journ. Geol. Soc. for Aug., 1880.) pp. 26. From the author.

Some Observations on the Menobranchus maculatus. By Henry Montgomery. (From Canadian Naturalist, Vol. IX, No. 3.) pp. 7, 1880. From the author.

Description of parts of the Skeleton of an Anomodont Reptile (*Platypodosaurus robustus*) from the Trias of Graaf Reinet, S. Africa. By Prof. Owen. (From Quart. Journ. Geol. Soc., Aug. 1880.) pp. 13, pls. 2. From the author.

Graptolites of the Niagara formation. By J. W. Spencer. (From Canadian Naturalist, Vol. 8, No. 8, pp. 7.) From the author.

On the Nipigon or Copper-bearing Rocks of Lake Superior, with notes on copper mining in the region. By J. W. Spencer. (From Canadian Naturalist.) pp. 15. From the author.

Notes on the Geology of the Iron and Copper Districts of Lake Superior. By M. E. Wadsworth. (Bull. of the Mus. Comp. Zoöl., Geol. Ser., Vol. I) pp. 157, pls. 6. Cambridge, 1880. From the author.

On the conditions to be filled by a Theory of Life. By C. S. Minot. (From Proc. Amer. Assoc. Adv. Sci., Aug., 1879.) pp. 5, Salem, 1880. From the author.

A Catalogue of the Birds of Indiana with keys and descriptions of the Groups of Greatest Interest to the Horticulturalist. By A. W. Braytons. pp. 76. Indianapolis, 1880. From the author.

Note on the Extension of Coiled Arms in Rhynchonella. By Edw. S. Morse. (From Amer. Journ. Sci. and Arts, Vol. 17, March, 1869.) pp. 1. Tokio, Japan, Nov. 26, 1878. From the author.

On the Tarsus and Carpus of Birds. By Edw. S. Morse. (From Ann. Lyc. Nat. Hist., New York, Vol. 10, 1872.) pp. 18, pls. 4–5. From the author.

On the Identity of the Ascending Process of the Astragalus in Birds with the Intermedium. By Edw. S. Morse. (From Mem. Bost. Soc. Nat. Hist., 1880.) 4to, pp. 10, pl. 1. From the author.

Description of a new species of Chamæleon from Madagascar. By Dr. A. Gunther. p. 1, 1 pl. Sept., 1879. From the author.

Description of new species of Reptiles from Eastern Africa. By Dr. A. Gunther. pp. 5, Sept., 1880. From the author.

A contribution to the knowledge of the Fish-fauna of the Rio de la Plata. By Dr. A. Gunther. (From Ann. and Mag. Nat. Hist., July, 1880.) pp. 7, pl. 1. From the author.

Ottawa Field Naturalists' Club. Transactions No. 1. 8vo, pp. 60, pls. 2. Ottawa, Canada, 1880. From the club.

Comptes Rendus Sténographiques des Congrès et Conférences. Congrès International de Géologie, Paris, Septembre, 1878. pp. 313. Paris, 1880.

Rapport sur la marche der Musée Géologique Vaudois en 1869. Par E. Renevier. (Ext. Bull. Soc. Vaud. Sc. Nat., 16, 83.) pp. 17. Lausanne, 1880. From the author.

Histoire Géologique du Canal de la Manche. Par M. Hébert. (Ext. Comptes Rendus Acad. des Sciences, T. 90, 1880.) pp. 13, 4to. From the author.

Le Pliocène de Castel d'appio en Italie. Par M. Emile Rivière. pp. 8, 1880.

De Quelques Hyperostoses de Poissons Trouvées dans les Grottes Quaternaires de Menton en Italie par E. Rivière. Assoc. Franc. pour l'Advanc. des Sci., Congrès de Montpellier, 1879. pp. 6. From the author.

Orographie de la partie des Hautes-Alpes Calcaires. By E. Renevier. 12mo, pp. 97. Lausanne, 1880. From the author.

Quelques Roches des Alps Vaudoises Etudiées au microscope. Par M. Arthur Wm. Waters. (Bull. Soc. Vaud. Sc. Nat. 16, 83.) pp. 6, pl. 1. From E. Renevier.

Zur Fisch-fauna des Cauca und der Flüsse bei Guayaquil. Von Dr. Franz Steindachner. 4to, pp. 52, pls. 9. Wien, 1880. From the author.

Ichthyologische Beiträge (IX). Von Dr. Franz Steindachner. Uber eine Sammlung von Flussfischen von Tohrzona auf Madagascar. (Sitzb. der k. Akad. der Wissensch. I, Abth. Juli-Heft. Jahrg. 1880.) pp. 29. From the author.

Anales del Ministerio de Fomento de la República Mexicana. 8vo, Tomo III, pp. 687. Mexico, 1880.

Circular of the Terzo Congresso Geografico Internazionale. Venezia, 1881. Roma, 1880. From the secretary.

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GENERAL NOTES.

BOTANY.

MECHANICAL CAUSE OF QUINCUNCIAL PHYLLOTAXY.—In a preliminary note on this subject, Prof. F. Delpino, of the Royal University of Genoa, describes the following experiment by which he has reached certain conclusions concerning phyllotaxy different from those usually adopted. Thirty or forty small spheres of equal diameter are fastened together as follows: the first, second and third are in contact; the fourth lies in the angle between them; the fifth is in the angle between the second, third and fourth; the sixth is in the angle between the third, fourth and fifth; and so on, each additional ball being placed in the angle between the three immediately preceding it in number. On the cylindroid thus formed the spheres occupy positions corresponding to those of the leaves in the quincuncial arrangement. Three spirals may be traced, having the formulæ $\frac{0}{1}$, $\frac{1}{2}$, $\frac{1}{3}$. Imagine now the spheres as thus placed to elongate gradually into horizontal cylinders, and the spirals will change successively to $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$; $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$; $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$; &c. His conclusions are that the cause of the quincuncial arrangement is exclusively mechanical; that the orthostichous and retiscriate arrangements are not due solely to mechanical causes, but are influenced by physiological, biological and hereditary circumstances; that leaves are not peripheral and lateral, but central and apical in their origin; that the cauline system does not exist, what has been considered such being only a congenital fusion of the bases of an indeterminate number of leaves, and merely a region which he proposes to call the phyllopodium or phyllopodial region; that the structural principle governing the formation of the body (corpo) in the higher cryptogams, gymnosperms and angiosperms is the simplest possible, being a continued, more or less purely mechanical, ascendant apposition of similar organs; that the higher plants are phyllo-

phytes, and not cormophytes, the only true cormophytes being certain algæ (Caulerpa, Chara); and that the leaf has the same structural significance in the phænogams and higher cryptogams, but that there is nothing in the lower cryptogams which corresponds to it.—*W. T.*

INFLUENCE OF HIGH AND MOIST TEMPERATURES ON GERMINATION.—The action of high and moist temperatures on germination has been recently studied by M. Hackel, who put seeds of black mustard (*Sinapis nigra*) on a moist sponge placed in a plate whose bottom was constantly covered with water, and kept the whole in a stove with constant temperature at 48° C. In less than twelve hours radicles were formed in a large number of the seeds (but none such were observed in seeds in the water kept there—they never generated). The seeds, having sent out their radicle, stopped while the temperature remained at 48°, but when it was lowered to 20° or (better) 17.5°, there was a rapid development of germs. Neither *Sinapis alba* nor *Lepidium sativum* gave a reproduction of the phenomenon. The substances, benzoate of soda (known to arrest the development of ferments), benzoic acid and sulphurous acid, were proved to be capable of suspending the germination of various seeds.—*English Mechanic.*

NECTAR, ITS NATURE, OCCURRENCE AND USES.—Under this heading Mr. William Trelease contributes to the report on Cotton insects lately issued by the Agricultural Department, an interesting essay, accompanied by a good plate and full bibliographical references. He concludes that "nectar, whenever it occurs, may be considered as excretory, reproductive, protective or nutritive; that in some cases, *e. g.*, the leaves of the peach, excretory nectar may possibly be protective also; that reproductive nectar usually occurs in the flowers but not always; that protective nectar seems, in some cases, designed to keep ants from defoliating and deflowering the plant; in others, to keep larvæ from destroying the foliage or immature fruit; that nutritive nectar may serve, in some cases, to lead to the capture of wingless, in others of winged insects, and finally that the vital force of a plant is taxed so little in the production of nectar, that glands once developed and endowed with the power of active secretion may continue to secrete for generations after the necessity for their secretion has ceased to exist.

BOTANICAL NOTES.—At the Swansea meeting of the British Association, Mr. Alfred W. Bennett, in a paper on the classification of the Cryptogams, proposed to retain Sach's class of Protophyta for the lowest forms of vegetable life; but to restore the primary division of the remainder of thallophytes into Fungi and Algæ, as being more convenient to the student, and at least as much in accordance with probable genetic affinities. He also, with Mr. G. Murray, read an essay on "a reformed system of ter-

minology of the reproductive organs of the Cryptogamia."——At a recent meeting of the French Academy, M. Planchon described a new species of American vine under the name of *Vitis Berlandieri.*——Messrs. E. A. Rau and A. B. Hervey have issued a Catalogue of North American Musci, giving the names of the species and the general localities.——A valuable contribution to the subject of insect-destroying Fungi has been published by Prof. A. Giard. Of these the most common is *Entomophthora muscæ*, so common in September and October in our apartments; a second type is *E. megaspermum*, a parasite of the cut-worm or larva of *Agrotis segetum*; others are *E. curvispora*, a parasite of *Simulium latipes*, a species of black fly, and *E. ovispora*, parasite of another fly (*Lonchæa vaginalis*). He regards Empusa and Tarichium as simply forms of Entomophthora, and to be used in the same sense as in zoölogy the nauplius or zoëa of a Crustacean. He describes as new a fungus parasite of the flesh fly, under the name of *Entomophthora calliphoræ*. He then describes the appearance of a gnat (Chironomus) attacked by the Empusa form of *Entomophthora rimosa*, and incidentally alludes to *E. conglomerata* of the mosquito. Finally M. Giard refers to the enormous services which Entomophthora renders to agriculture. "Nothing could be more easy than to multiply these parasites, and to introduce them into places where they had not hitherto existed." The caterpillars of the cabbage butterfly can be exterminated by watering them with water containing the spores of *E. sphærosperma*. By collecting, in winter, these caterpillars, mummified and filled with spores, they can be used in destroying the hordes of caterpillars of the next summer. Giard also recommends destroying the cut-worm by sprinkling over cabbage beds water holding the spores of the fungus in suspension.——Some peculiarities in the anthers of Clethra are described, by C. R. Barnes, in the *Botanical Gazette* for August and September.

ZOOLOGY.[1]

Eggs of the Tree Cricket wanted.—The undersigned would be much obliged for specimens of the eggs of the tree cricket (Œcanthus). They are laid in the terminal branches of the raspberry, plum, oak, grape, and almost any shrubs. The rows of punctures made by the ovipositor of the female are quite easily detected, and may be found during the Autumn and Winter. Send twigs by mail.—*A. S. Packard, Jr., Providence, R. I.*

Do Flying Fish Fly.—In the September number of the Naturalist is a very interesting article on the subject, "Do Flying Fish Fly?" During the past summer I have been enabled to witness the flight of a good many flying fish of the large species

[1] The departments of Ornithology and Mammalogy are conducted by Dr. Elliott Coues, U. S. A.

known as *Exocœtus californicus* Cooper. The following extract from my field notes may be of some interest as bearing on this question:

It flies for a distance sometimes of nearly a quarter of a mile, usually not rising more than three or four feet. Its motions in the water are extremely rapid, and its motive power is certainly the movement of its powerful tail in the water. On rising from the water the movements of the tail are continued for some seconds until the whole body is out of the water. While the tail is in motion the pectorals are in a state of very rapid vibration, and the ventrals are folded. When the action of the tail ceases, the pectorals and ventrals are spread and, as far as we can see, held at rest. When the fish begins to fall, the tail touches the water and the motion of the pectorals recommences, and it is enabled to resume its flight, which it finally finishes by falling in the water with a splash. When on the wing it resembles a large dragon-fly. The motion is very swift; at first it is in a straight line, but this becomes deflected to a curve, the pectoral on the inner side of the arc being bent downward. It is able to some extent to turn its course to shy off from a vessel. The motion seems to have no reference to the direction of the wind, and we observed it best from the bow of a steamer off Santa Catalina island, in early morning, when both air and water were free from motion.—*David S. Jordan, Ind. State Univ., Bloomington, Ind.*

Flights of "Flies."—Under the head of "traveling flies," the *Scientific American* notices the occurrence of a vast cloud of flies on the Hudson river, between New Hamburg and Newburg. It reached southward from shore to shore as far as the eye could reach, and resembled a great drift of black snow. The insects were flying northward "as thick as snow flakes driven by a strong wind." The steamer *Mary Powell* ran into the fly storm off Haverstraw, some forty miles below where the *Martin* encountered it. The flies were "long and black and had light wings."

A dispatch from Halifax, Nova Scotia, states that on Sunday, Sept. 5, immense swarms of flies passed over Guysboro, 120 miles northeastward of Halifax. They came from the east and resembled a dark cloud.

A correspondent of the Toronto *Mail*, writing from East Pictou, Nova Scotia, describes a similar phenomenon as occurring there August 21. The flies, forming a veritable cloud, passed Lismore at 6 o'clock in the evening, close to the shore. They went with the wind, which was blowing lightly from the west, occupying about twenty minutes passing a given point. They made a loud, buzzing noise, which was heard by many who missed seeing them. They flew so low that some of them appeared to fall into the water. About two miles below Lismore they slightly changed their flight, heading more to the north.

CETONIA INDA.—This common insect which in former years was a harmless beetle feeding in early spring on the sap of freshly cut maple trees has, within two or three years, become very abundant and destructive in different parts of New England. During the past summer it collected in great numbers on green corn, eating the kernals and partly destroyed a field in Middleboro, Mass., as we learn from Prof. Jenks.—*A. S. P.*

CAUSE OF THE TWISTING OF SPIRAL SHELLS.—At the end of his essay on the development of the pulmonate Gasteropods, M. Fol inquires into the cause of asymmetry of univalve shells; by most authors it has been ascribed to the folding round of the shell; Ihering, however, regards the torsion of the shell as due to the asymmetry of the viscera. Fol regards both these opinions as too extreme, as in the Heteropoda asymmetrical arrangements manifest themselves at an extremely early period. In Helix and Limax the torsion does not appear so early, and is seen simultaneously in the viscera and in the shell. To explain the phenomena, it seems to be necessary to note the process of segmentation of the ovum; but here unfortunately there is but little information. The fact that organs like the kidneys, which are, as we know, primarily double, are in the youngest of Gasteropod larvæ, single, seems to show that the asymmetry is produced prior to the commencement of the embryonic period. In conclusion, as reported in the Journal of the Royal Microscopical Society, the author points out how recent observations tend to favor the reëstablishment of the *Vermes* of Linnæus. It is impossible, Fol says, to compare the molluscan larva with a segmented worm larva; they only correspond to the cephalic portion of the larva of an Annelid, or to an entire Rotifer; the Mollusca are not segmented animals which have fused their segments, but they are animals which have remained simple. In the Vermes, on the other hand, the larval form (Lovenian, veliger, trochosphere) can, with variations in form, be traced through "worms," Annelids, Bryozoa, Brachiopods, and even Echinoderms, and these all form a phylum quite distinct from that of the Arthropoda on the one hand, and of the Chordata (Tunicata and Vertebrata) on the other.

THE YOUNG OF THE CRUSTACEAN LEUCIFER, A NAUPLIUS.—One of the most interesting observations which we have made this summer is, that Leucifer leaves the egg as a Nauplius. As Fritz Müller did not raise the young of Peneus, but relied upon surface collecting, his observations are not absolutely conclusive, but I have seen Leucifer lay its eggs, and I have seen the exit of the Nauplius from the egg, so the occurrence of a Nauplius is proved, absolutely, in one stalk-eyed Crustacean.

As almost nothing was known about the habits of Leucifer, and nothing whatever about its embryology, I have devoted especial

attention to this interesting species this summer, but although the animals are very abundant I have been baffled in all my attempts to find the eggs or young until within the last week, but have now got on to the right track, and can get a complete history if the weather is calm for a week longer.

The animals are remarkably regular in their breeding habits. They copulate late in the afternoon; the eggs are laid about nine o'clock in the evening, and they hatch in about thirty-six hours. The eggs are attached very loosely in an irregular bunch of about twelve or fourteen, to the last pair of thoracic appendages. They fall off at the slightest touch, and this, together with the rapidity of their development, explains the failure to find them in specimens collected at the surface. As they do not flourish in confinement, the eggs cannot be procured in any quantity from captive specimens, and until their breeding habits were known, the investigation presented great difficulties. By going out about eight o'clock on a calm evening and dipping very carefully with a hand net, a great number of individuals may be procured, and if these are carried home with great care and left undisturbed until about ten o'clock, careful examination will then show that several specimens have bunches of new-laid unsegmented eggs. If these specimens are carefully picked out, and placed by themselves, they can be kept, without much difficulty, until the eggs hatch, on the second morning after the adults were collected.

The course of development is of unusual interest, as Leucifer, like Amphioxus, presents what must be regarded as an unmodified embryonic history. Segmentation is total and perfectly regular, and the cells double their number at each cleavage, even after they have become very small, and many hundreds in number.

There is a true invaginate gastrula, which is as beautifully simple, and unmodified as the well-known gastrula of Sagitta.

The Nauplius is a typical nauplius, very much like that of a barnacle, or that of Cyclops, and is a marked contrast to the peculiar and specialized Nauplius of Penæus. If I had not seen it hatch I should certainly have supposed it to be a Copepod embryo, as the resemblance is perfect.

In this connection I may state that Mr. Wilson has succeeded in raising zoëas from the eggs of Libinia, and of a closely-allied genus. In these, the most highly specialized of the Decapods, the embryonic record is accelerated so much that the zoëa has its full number of thoracic appendages when it leaves the egg, so the embryology of Leucifer is at one end of the series and the embryology of Libinia at the other.

Wilson has also raised the zoëas of the following crabs from the egg; this summer: Porcellana, Pinnixa, Sesarma, Pinnotheres, Callinectes.

The skin which the crab zoëa sheds soon after it leaves the egg has been regarded as a Nauplius skin, but the fact that the Naup-

lius of Leucifer leaves the egg encased in a similar skin, and molts it soon after, seems to indicate that it has no morphological significance.—*W. K. Brooks, Beaufort, N. C., Sept. 5.*

THE FRIGATE MACKEREL, AUXIS ROCHEI, ON THE NEW ENGLAND COAST. — The United States Fish Commission has obtained numerous specimens of a fish, before entirely unknown in the Western Atlantic. This is the frigate mackerel, *Auxis rochei*, twenty-eight barrels of which were taken in a mackerel seine, ten miles east of Block island, on the 3d of August, by the schooner *American Eagle*, Capt. Josiah Chase, of Provinceton, Mass.

The Frigate mackerel resembles in some particulars the common mackerel, in others the bonito; the genus Auxis being intermediate in its character between the Scomber and the related genera Pelamys and Orcynus. It has the two dorsal fins remote from each other as in Scomber, and the general form of the body is slender, like that of the mackerel. The body is, however, somewhat stouter, and instead of being covered with small scales of uniform size, has a corselet of larger scales under and behind the pectoral fins. Instead of the two small keels upon each side of the tail which are so noticeable in the mackerel, it has the single more prominent keel of the bonito and the tunny. Its color is grayish-blue, something like that of the pollack, the belly being lighter than the back. Under the posterior part of the body, above the lateral line, are a few cloudings or maculations resembling those of the mackerel. The occurrence of a large school of this beautiful species in our waters is very noteworthy, for the fish now for the first time observed are very possibly the precursors of numerous schools yet to follow. It is not many years since the bonito became an inhabitant of our waters, and the distribution and habits of the frigate mackerel are supposed to be very similar to those of the bonito, *Sarda pelamys*, and the little tunny, *Orcynus alliteratus*, which also first came on the coast in 1871, and have since been found in considerable numbers.

The frigate mackerel has been observed in the West Indies and other parts of the tropical Atlantic as well as on the coast of Europe. In Great Britain it is called the "plain bonito." It is not unusual in the Bermudas, where it is called the "frigate mackerel," a name not inappropriate for adoption in this country, since its general appearance is more like that of the mackerel than the bonito, while in swiftness and strength it is more like the larger members of this family.

Since the first appearance of this fish many new observations of its abundance have been received. These fish seem to have come in immense schools into the waters between Montauk point and George's bank, and from Mr. Clark's statements it appears that they have been observed in small numbers by fishermen in previous years. Several vessels have come into Newport recently, reporting their presence in immense numbers in the

vicinity of Block island. It will interest the "Ichthyophagists' Club" to know that several persons in Newport have tested the fish, and pronounce it inferior to the bonito. Part of the flesh, that on the posterior part of the body, is white, but behind the gills it is black and rank, while the meat near the backbone is said to be of disagreeable, sour flavor.

It is hard to predict what its influence will be upon other fishes already occupying our waters. Its mouth is small and its teeth feeble, so that it is hardly likely to become a ravager like the bonito and the bluefish. There is little probability, on the other hand, that its advent will be of any special importance from an economical point of view, for its oil does not seem to be very abundant, and it would hardly pay at present to capture it solely for the purpose of using its flesh in the manufacture of fertilizers.

Mr. A. Howard Clark, in charge of the Fish Commission station at Gloucester, has communicated to Prof. Baird some interesting facts regarding its abundance. From these statements it would also appear that the species has been observed occasionally in past years. He writes under date of August 10th: "I have received this morning from the schooner *Fitz J. Babson*, just arrived from Block island, a fish answering to your description of the Auxis, having a corselet of scales around the pectoral fin as in the tunny. The captain of the vessel, Joshua Riggs, reports that about a week ago he had a hundred barrels in the seine at one time, and saw over twenty schools of them. He saw them as far east as Sow-and-Pig light ship. They are very easy to catch, flip like menhaden, do not rush, and are not frightened at the seine. They go in immense numbers, he thinks, as many as one thousands barrels to a school. The day after the appearance of these fish the mackerel disappeared, but he does not know whether the mackerel were driven away by them or not. They feed on mackerel food. Mr. Daniel Hiltz, of the same vessel, says that he caught one of just the same kind in February, 1879, on a haddock trawl on the eastern part of the Middle Bank in forty fathoms of water. He took it to Boston, where it was called a young bonito."

Mr. John Henderson, of the schooner *Sarah C. Wharf*, says that two vessels caught such fish recently, eastward of here; the schooner *American Eagle*, of Provincetown, took a number of barrels of them into Newport, and sold them for a dollar a barrel. Another Cape Cod vessel, he does not know her name, took about fifty barrels of them and threw them away. All the mackerel seiners from Block island report seeing quantities of this new fish within the past fortnight. The captain of the schooner *Sarah C. Wharf* says he first saw them a fortnight ago some fifteen miles off Block island. The captain and several of the crew of the *Ella M. Johnson*, of Newburyport, just arrived from Block island, state they saw abundance of the Auxis, but did not know what it was

until reports came from you at Newport. They opened one and found in its stomach the ordinary red mackerel food. This crew differ with the crew of the schooner *Fitz. J. Babson* with regard to the ease of capturing them—think them rather difficult to take; say they flip like porgies, and do not rush like mackerel; they saw ten large schools of them on Saturday last when some fifteen miles south of Block island.

I hope that any reader of the AMERICAN NATURALIST who has seen this fish will mention it; some may, perhaps, have an opportunity of studying its habits. The length of those I have seen ranges from twelve to sixteen inches, and their weight from three-quarters of a pound to a pound and a-half or more. Those sent to New York market were part of the lot taken by the schooner *American Eagle* and brought into Newport, whence they were shipped by Mr. Thompson, a fish dealer of this place. It would require from eighty to one hundred of them to fill a barrel, so the estimate of Capt. Riggs that there are a thousand barrels in one of the schools, shows how exceedingly abundant they must be.

Capt. N. E. Atwood, of Provincetown, Mass., the veteran fisherman-ichthyologist, has examined the specimens, and is satisfied that they belong to the same species as fish which he found abundant in the Azores in 1840, when, led by the reports of Cape Cod whalers, he went to these islands in search of mackerel, the mackerel fishing being poor at home. No mackerel were found except the "frigate mackerel" referred to in this note.—*G. Brown Goode, Summer Station U. S. Fish Com., Newport, R. I., Aug. 30, 1880.*

ON THE OCCURRENCE OF FREIA PRODUCTA WRIGHT, IN THE CHESAPEAKE BAY.—Sometime in 1851 Prof. Leidy called attention to the existence of *Freia ampulla* in American waters, and from the poor figures of the European form then in existence, he was led to consider it a new species under the name of *F. americana*, but he now considers both forms the same. As they are amongst the most singular and beautiful of the family of the trumpet animalcules or Stentorina, I take pleasure in announcing that I have found the still more interesting species, *F. producta* T. S. Wright, in shallow waters on the western shore of the Chesapeake, attached in vast numbers to the shells of oysters, in company with ? Loxosoma and other bryozoa.

The tubes in which the animalcule resides are formed of a narrow transparent ribbon of horny consistency, wound into a spiral and terminating in a trumpet-shaped extremity from which the odd peristome of the inhabitant protrudes. The basal or attached end of the tube is usually bent at an angle to the tube and bears a striking resemblance to the foot end of a stocking fastened to some other object by the surface on which the sole rests. This portion is not composed, like the tube, of a spiral ribbon, but is simply a thin-walled sac, from the open end of which the ribbon

takes its rise, but it is composed of the same kind of material. Many of the tubes show the rim of a trumpet projecting from the sides of the former, a little above the middle, and of the same form as the terminal rim, showing that this, like the form described by Mr. Wright from English waters, may stop building its tube for a time and then recommence.

The adult animal, tube and all, when fully extended, will measure $\frac{1}{25}$ of an inch in length. It is of the same color as *Stentor cæruleus*, but has the power of elongating and twisting itself as greatly as *S. ræseli.* The peristome is quite unlike that of *Freia ampulla* and bears a strong likeness to the blades of a pair of obstetrical forceps. The blades are deeply grooved, forming a deep ciliated demi-canal with parallel sides, and at the junction of their bases lies the spacious, twisted and richly ciliated pharynx, which is bounded dorsally and ventrally by the prominent folds which unite on either side with the long, curved lobes of the peristome. As in *F. ampulla* a finger-shaped knob, which may sometimes be extended as a long flexible appendage, surmounts the apices of the lobes of the peristome. There is a small basal disc as in Stentor and the ectosarc is traversed as in that genus by parallel granular bands, regarded as muscle fibers by some writers. The usual food balls and vacuoles are present, and I was enabled to define sharply the endosarc from the ectosarc, and clearly see the long-beaded nucleus. The tube or ribbon-secreting organ described by Wright I was unable to discover.

When fully extended the basal portion of the animal becomes attenuated to a thin bluish filament, which widens toward the peristome, where the body is over half as thick as the diameter of the tube. When fully retracted and resting, the animal resembles in its oblong shape a retracted and resting Stentor, and measures about $\frac{1}{10}$ as long as when fully extended. The agreement of this form with *F. producta* is in every respect so complete, that I have no doubt whatever that they are the same. The ribbon makes from four to twenty-four turns in specimens of different ages, and the turns are to the right. *F. stylifer* Wright, is probably only a variety of this species.—*John A. Ryder, Sept. 3d, 1880.*

RHIPIDODENDRON SPLENDIDUM.—This remarkable flagellate monad, which builds a fan-shaped test composed of radiating tubes in which the individuals live and divide, is not uncommon, attached to the leaves of Sphagum, from ponds in the neighborhood of Woodbury, N. J., from whence I have obtained it in material furnished me by Mr. W. P. Seal. Prof. Stein first described it from Bohemian waters.—*J. A. Ryder.*

A PALE VARIETY OF POLYXENES FASCICULATUS.—I have just picked up some specimens of Polyxenes that seem to me unusually pale in color. I find them under chips, sticks and bits of bark within forty feet of the sea beach, at St. Jerome, St. Mary's

county, Md., on the Chesapeake bay. The beach at this place is composed of white sand, and these little myriapods seem to have acquired a reddish tinge with none of the bluish cast so characteristic of specimens which I have examined from the vicinity of Philadelphia. There is so little pigment in the body walls that with careful illumination I am able to see the viscera, filled with ingesta, very plainly. There are no other differences by which I can distinguish the form from *P. fasciculatus* Say. It may be called var. *pallidus*.

I wish also to record that all the inland specimens which I have found were always observed under the bark of trees, a fact which, I think, Mr. Say also records, but these I find invariably on the ground and in great numbers underneath the objects mentioned. —*J. A. Ryder*.

ZOOLOGICAL NOTES.—A communication has been found by F. W. Bennett between the air-bladder and the cloaca in the herring. ——The structure of the ovary, ovulation, fecundation and the first stages of development in the bats has lately been studied by Messrs. Van Beneden and Julin. A contribution to the study of the structure of the ovary of the mole, ermine and bat (*Vesperugo pipistrella*) by J. MacLeod, appears in Van Beneden and Bambeke's Archives de Biologie.——A good deal of attention is now being paid by anatomists to the nervous system of the lower animals, especially the ganglionic centers. A useful tract bearing on this subject is Liénard's "Constitution de l'Anneau Œsophagien." ——Mr. J. A. Lintner's Lepidoptera of the Adirondack region is an interesting contribution to zoö-geography, especially to our knowledge of the sub-arctic life of these mountains. It appears in the seventh report of the Adirondack Survey.——The researches carried on by the U. S. Fish Commission the past season from Newport out to the Gulf Stream, have resulted in the addition of a large number of new fishes and marine invertebrates. The hauls made in about three hundred fathoms under the edge of the Gulf Stream revealed a strange mixture of tropical and arctic life, with abyssal forms, including many shells and an interesting new starfish; 150 species new to the coast being dredged in a single day.——M. Fabre has discovered that two species of Halictus, a genus of bees, are parthenogenetic. They have two generations a year; a vernal and sexual one, originating from females which, fecundated in autumn, have passed the winter in their cells; the other æstival and due to parthenogenesis. From the union of the two sexes females alone develop; from parthenogenesis a brood of both females and males result. Aside from the Aphides these bees are, Fabre claims, the first example known of a sexual generation alternating with reproduction without union with a male.——A remarkable form of Pedicellaria and the functions performed thereby are described by W. P. Sladen in the Annals and Magazine for August.——Villot, after further

study of the hair worms now asserts that the larvæ of the Gordii do not select their hosts; they encyst themselves and become developed in the most different animals (batrachians, fishes, crustaceans, Arachnida, insects and mollusks). It is, therefore, by no means the case that the larvæ of the hair worms are parasites peculiar to insects; they probably most frequent fishes, and only exceptionally infest terrestrial animals, and only these when accidentally exposed to water, many insects, as ground beetles, mantidæ, grasshoppers and locusts perishing in this way; the Gordii in them being set at liberty.

ANTHROPOLOGY.[1]

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON.—On the 10th of February, 1879, at the invitation of Dr. J. Meredith Toner, Col. Garrick Mallery, U.S.A., and Prof. Otis T. Mason, a few gentlemen interested in the study of man, met in the Smithsonian Institution to devise a method of mutual improvement. The effort resulted in the formation of the Anthropological Society of Washington, with Maj. J. W. Powell for president, Dr. Elmer R. Reynolds, recording secretary, and Otis T. Mason, corresponding secretary. The purpose of the members being to compare notes upon their different fields of research, the organization had no pretentious designs. It is not yet decided whether the journal will be published, inasmuch as the Smithsonian Institution and the Bureau of Ethnology afford ample opportunities of preserving all papers of permanent value.

The following is a list of papers read from the foundation of the society to the end of the year 1879:

1. Indian Pictographs. G. K. Gilbert.
2. Aztec and Guatemalan Antiquities. Otis T. Mason.
3. Arrow-making. Frank H. Cushing.
4. Color Blindness. Dr. Swan M. Burnett.
5. Prehistoric Archæology. Wills de Hass.
6. Indian Color Names. A. S. Gatschet.
7. Indian Pictographs. Miles Rock.
8. French and Indian Half-breeds. Dr. Victor Havard, U.S.A.
9. Indian Color Names. Albert S. Gatschet.
10. Comparative Mythology of the Indies. Col. Garrick Mallery, U.S.A.
11. Aboriginal Cemeteries near Piscataway, Md. Dr. Elmer R. Reynolds.
12. The Zoölogical Relationship of Man. Prof. Theodore N. Gill.
13. The Sign Language of the N. A. Indians. Col. Garrick Mallery, U.S.A.
14. Poisoned Weapons of the N. A. Indians. Dr. Wm. J. Hoffman.
15. Fertilizers employed by the N. A. Indians. G. Browne Goode.
16. Comparison of a written language with one that is spoken only. Otis T. Mason.
17. Aboriginal Shell Mounds at Pope's Creek. Dr. Elmer R. Reynolds.
18. Ancient Maps of N. America. John C. Lang.
19. Comparison of Forest and Geological changes in the Tropics. Miles Rock.
20. Estimation of the age of Prehistoric Remains. Capt. Edwin P. Lull, U.S.N.
21. Turtle-back Celts and their Uses. Dr. Elmer R. Reynolds.
22. Aboriginal Shell-heaps on South River, Md. J. D. McGuire.
23. Unclassed Disc-shaped Implements from Benning's, D. C. Dr. Elmer R. Reynolds.
24. A Strange old Chart. Lt. Com. W. Bainbridge Hoff, U.S.N.

[1]Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

THE DAVENPORT ACADEMY.—The Academy of Natural Sciences of Davenport, Iowa, has just issued Part II of Vol. II, from July, 1877, to December, 1878, and Part I Vol. III, to January 1, 1879. Wherever Prof. J. D. Putnam and Dr. C. C. Parry are to be found, one reasonably expects to hear of entomology and botany, and the volumes before us are largely indebted to these gentlemen for what they contain of lasting value. A goodly space, however, is devoted to what immediately concerns this department, as the following list of papers will show:

VOL. II:

Exploration of Mounds on the farm of Col. Wm. Allen. W. H. Pratt.
Examination of a large Mound in Jackson county, Iowa. Rev. J. Gass.
A review of the published statements regarding the Mound at Payson, Utah. By Dr. E. Palmer.
Inscribed Rocks in Cleona Township. Rev. J. Gass.
Report on the Mounds of Jackson County. Rev. J. Gass.
Left-handedness in the City Schools. W. H. Pratt.
Mound No. 11, Cook's farm, and an Inscribed Tablet. C. E. Harrison.
The Shell Mounds of Florida. W. W. Calkins.
Curious relic from the Cook farm. W. H. Pratt.
On the East Davenport Mounds. A. D. Churchill.
Mound near Moline, Ill. Rev. J. Gass and Dr. R. J. Farquharson.
Exploration of Indian Graves. Rev. J. Gass.
Elephant and Bear Pipes, illustrated.

Most of these communications are, for the present of local interest. The time will soon come, however, when these special labors will be generalized into a consistent system embracing the archæology of our entire continent. On pages 156–162, Vol. II, Mr. Pratt describes shell beds in the vicinity of Davenport, which he considers to be of natural formation. It would be well for some of our shell-heap friends to look into the matter. To discover that natural causes had coöperated with man in building mounds and shell heaps, would affect materially our theories concerning both. Dr. Palmer, pages 167–172 takes entirely too much notice of a canard concerning giants and mummy wheat. The description of the mode of building up the mound is excellent, and Dr. Palmer has the credit of being the first to draw attention to these tent mounds. It is to be sincerely hoped that no respectable journal will hereafter help to propagate archæological weeds. The short paper by Mr. W. H. Pratt on left-handedness, p. 186, is an excellent contribution to a special subject. The paper of Mr. Harrison, pages 221–224, touches on a topic of absorbing interest. The late Prof. Henry was in the habit of calling all observations which did not readily fall into some known class, outstanding phenomena. The tablets of Davenport and the more recently discovered elephant pipes are, at present, outstanding phenomena. We may provisionally enumerate the groups of objects in one of which they must go: 1. It has been said that they are downright frauds. The veracity of the many scientific gentlemen in the Academy which has been staked upon the genuineness of the finds, forbids such a conclu-

sion. 2. In a late number of the *American Art Review*, Mr. F. W. Putnam draws attention to an Egyptian idol in a Florida mound, and after weighing the evidence, inclines to believe it a "plant." If the Davenport tablets and pipes are clever "plants," some very shrewd gentlemen have been hoaxed, but really it is unkind to harbor such thoughts if there is any other possible explanation of the phenomena. 3. While many of the mounds of this continent are of unknown antiquity, it is proved beyond a doubt that many are quite recent. It is within the range of possibility that the mounds at Cook's farm were constructed after the Indians had received from the Catholic missionaries an idea of recording events upon bark, stone, metal, etc. 4. Granting the Asiatic origin of the Mound-builders, it is not inconceivable that the recollection of the elephant and of written characters, which play such a prominent part in the civilization of Asia, should have been brought to this continent and permanently recorded in stone. 5. It is yet an open question whether man existed on this continent contemporaneously with the mastodon, or, what amounts to the same thing, whether the mastodon survived until man had appeared in America. If such had been true, we have in our elephant pipes another graphic witness of this acquaintanceship. 6. The theory that these graphic signs and images are only undesigned coincidences will close our list of conjectures for the present regarding these truly wonderful objects. The paper of Mr. Calkins on the Florida Shell-mounds has interested us very much. This branch of archæology is now being thoroughly worked up by Le Baron, Gilman, Walker and others, under the patronage of the Peabody Museum and the United States Fish Commission. The latest testimony is rather unfavorable to the cannibal theory.

ANTHROPOLOGY IN FRANCE.—The second number of the *Revue d'Anthropologie* for 1880 is up to the standard both in its original articles and in its reviews. The following list of original papers shows how completely the area of anthropology is covered by our colleagues in France: Essai d'Anthropométrie (comparison of the bi-trochanterian diameter of the human body with the bi-iliac diameter) by Charles Féré; Essai sur les méthodes numériques qui permettent d'apprécie la fécondité et la vitalité, by Charles Richet; Sur la transformism, by Dr. Périer; Recherches anthropometriques sur les effets de la gymnastique d'entraînement, by Drs. Chassange and Dally; Ethnologie du Portugal, by M. J.-J. Da Silva Amada.

The observations of Dr. Féré were made upon 133 males and 67 females. Without attempting to repeat his processes, we may give some of the author's results. There is no fixed relation between the width of the skull and of the pelvis, notwithstanding M. Pruner-Bey thinks that the form of the cranium agrees with that of the thorax and of the pelvis in well marked races. Again, while the proportions of the diameter of the skull and of the bi-

acromial diameter decrease gradually and in a quite regular manner in both sexes as the height increases, and they are generally less in females, the bi-iliac and the bi-trochanterian diameters present numerous variations. Dr. Richet, in his paper on fecundity, discusses the relation of vitality to fecundity by means of a series of algebraic formulæ. The chief merit of the communication is the emphasis given to the fact that the mere counting of the offspring of a single generation of mulattoes is not a correct guide to their fecundity. It is well known that very feeble mothers frequently have many children, all of whom perish in childhood, while vigorous mothers, less fecund, raise all their children, and thus contribute to the succeeding generation a proportional number of fathers and mothers. It will be seen at once that the question of the permanence of hybrids depends quite as much on the vitality of the offspring as upon the fecundity of the mothers. Dr. Périer, in his note on evolution, calls attention to the fact that the theory of "transformism" has been received with greater enthusiasm in England and Germany than in France, the land of its birth. The author inclines to compliment his countrymen for this state of things, and, for himself, is happy "to be among the number of those who bow before the inaccessible unknown, and who prefer the philosophic doubt to conceptions however lofty they may be, which are, after all, only learned errors." The following paper on anthropometry applied to gymnastic training treats of that practical side of our science which answers the question *cui bono* asked every minute by those practical people who have the bills to pay. The investigations reported were made at the military school of Joinville, and are divided into three classes: 1. Gymnastic anthropometry, or determination of the development of the thorax, muscles, and dynamics by gymnastic exercises; 2. Military anthropometry, or the determination of thoracic and muscular development by normal military exercises, or life in the regiment; 3. Professional anthropometry, or researches upon the mean development of the thorax, muscles, and dynamics produced by professional or civil life. To these are added, verification of the law of the relation of weight to the number of centimetres above a metre in stature; mean dynamic force, general and special, of men at twenty-three years of age; conclusions and the demonstration of the utility of gymnastic practice in the barracks and in the school. A bibliographic list accompanies the essay and adds very much to its value.

Anthropology in England.—The May number of the *Journal of the Anthropological Institute* contains, in addition to the president's address, the following papers of general interest: Australian marriage laws, by Rev. Lorimer Fison; Savage and civilized warfare, by J. A. Farrer; Notes on the Jivaros and Canelos Indians, by Alfred Simson; On the Bheel tribes of the Vindhyan

range, by Col. W. Kincaid; The Ethnology of Germany, Part IV: the Saxons of nether Saxony, Section II, by H. H. Howorth.

Mr. Tylor's address is a model for all such orations. Going beyond the custom of his predecessors, he commences with a tribute to the work of foreign societies, but, alas, finds no good word for American laborers. Following this we are presented with a résumé of work done by British anthropologists. Mr. Fison, in a letter to Mr. Tylor, gives a detailed statement of class marriages in Australia, accompanied with a chart. Mr. Farrer develops the idea that among savage races there are laws of war; that the instances are rare "where no notice nor declaration of war is made, but one tribe falls on another with no more warning than would be considered obligatory by a pack of wolves." The tribes described by Mr. Simson dwell in Ecuador. The author has been for years a resident of the country, and speaks from personal observation. The Bheel tribes described in Col. Kincaids paper live on the hills and in the villages bordering on the Vindhya mountains, a range stretching across Hindostan from east to west, just north of the Nerbudda river, extending from 22° to 25° N. The village Bheels are employed by the people among whom they dwell as trackers of stolen property, which custom is well described by the author, as well as the methods of oath taking, superstitions and marriage ceremonies.

Mr. Howorth's paper occupies thirty pages of the *Journal* and is a continuation of the author's exhaustive monographs upon the tribes inhabiting Europe in the earliest classical times.

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GEOLOGY AND PALÆONTOLOGY.

GEOLOGY OF EGYPT AND OF THE LIBYAN DESERT.—Prof. Carl Zittel has published in the Abhandlungen of the Royal Academy of Munich for 1880, an essay on the above subject. It is largely based on the observations and collections of Schweinfurth and Güssfeld. As is known, the order of succession of the formations in Northern Africa is from the older in the south to the later in the north. An exception to this is found in the region bordering the Red sea, where a long extension northward of the primitive Azoic formation exists. Dr. Zittel shows that the greater part of the region west of this primitive plateau consists of the upper and lower Nummulitic Eocene. To the south and southwest the Cenomanian Cretaceous comes to the surface, the lower beds especially appearing from beneath lines of Eocene or upper Cenomanian bluffs. The oases are excavations in the latter formations, whose bottoms consist of the Lower Cenomanian.

VERTEBRATE PALÆONTOLOGY OF INDIA.—Dr. Lydekker continues to make important contributions to this subject. His latest is a memoir on the Siwalik and Narbada Proboscidia, in which a great deal of light is thrown on the structure of the dentition of many of the species. Two species are named for the first time, *Dinotherium sindiense* and *Mastodon falconeri* (a trilophodont), while several others are described for the first time under MS. names of Falconer. In a preface the author puts the Indian species of *Rhinoceridæ* in order, and gives information not hitherto accessible, by which they may be referred to their proper genera.

In the Journal of the Asiatic Society of Bengal for 1880, Dr. Lydekker gives a synopsis of the species of extinct Vertebrata hitherto found in the peninsula of India. He enumerates twenty-eight species of fishes, mostly Palæozoic; seventeen of Selachii, mostly Mesozoic; thirty-nine Reptilia and Batrachia, divided

equally between the Mesozoic and Tertiary, and one hundred and twenty-five Mammalia.

THE GEOLOGY OF THE LOWER VALLEY OF THE DELAWARE.—Mr. H. C. Lewis has recently investigated this subject, and presents us with the following résumé of his results in the Proceedings of the Philadelphia Academy:

Forming the N. W. boundary of the Philadelphia gravel and brick-clay is a hill of gneiss, rising two hundred feet or more above the river, which may be called the Upland Terrace. It has a N. E. and S. W. trend, and in this vicinity is at an average distance of five miles from the river.

Within the Upland Terrace, resting upon its slope and extending to the river, is a series of stratified gravels and a boulder-bearing brick-clay. Of these the oldest is the "Fossiliferous gravel;" a gravel lying near the terrace and under the brick-clay, and containing pebbles which frequently are fossiliferous. Of more recent age, and at a lower level, is the "Philadelphia red gravel," which is made up of the pebbles of the Fossiliferous gravel mixed with fragments of Triassic red shale and other rocks brought down the Delaware valley. It is distinctly stratified, rests upon decomposed gneiss, and contains rounded boulders dropped by floating ice. Upon both of these gravels rests the Philadelphia brick-clay, often lying unconformably upon them in a series of pot-holes or wave-like forms, and apparently an aqueous deposit.

A yet more recent formation, the "River gravel and sand," lies within the others and close to the river, and is made up of flattened pebbles composed of the rocks over which the river flows. Upon this, in the river flats, lies a modern mud, the "Recent Alluvium."

Back of the Upland Terrace, isolated patches of two surface deposits, more ancient than any yet described, lie upon the hills. These are, the "Branchtown clay," at a height of two hundred and fifty feet, containing boulders of Potsdam rocks but no traces of Triassic red shale or of fossiliferous pebbles; and the "Bryn Mawr gravel," which caps hills of a higher elevation, and which, containing boulders and pebbles of identical material with those of the last, is characterized by the presence of a hard iron conglomerate or sandstone. This conglomerate, occurring also in New Jersey, and named the "Mt. Holly Conglomerate," is conjectured to be of Tertiary age.

In these seven formations is written the geological history of the Delaware valley.

ORIGIN OF CORAL REEFS AND ISLANDS.—*Nature* for August 12th contains a suggestive essay on this subject by Mr. John Murray of the Challenger expedition. His views do away with the great and general subsidences required by Darwin's theory,

and are in harmony with Dana's views of the great antiquity and permanence of the great ocean basins, which all recent deep-sea researches appear to support. Murray thus summarizes his views:

1. That foundations have been prepared for barrier reefs and atolls by the disintegration of volcanic islands, and by the building up of submarine volcanoes by the deposition on their summits of organic and other sediments.

2. That the chief food of the corals consists of the abundant pelagic life of the tropical regions; and the extensive solvent action of sea water is shown by the removal of the carbonate of lime shells of these surface organisms from all the greater depths of the ocean.

3. That when coral plantations build up from the submarine banks they assume an atoll form, owing to the more abundant supply of food to the outer margins, and the removal of dead coral rock from the interior portions by currents and by the action of the carbonic acid dissolved in sea water.

4. That barrier reefs have built out from the shore on a foundation of volcanic débris or on a talus of coral blocks, coral sediment, and pelagic shells, and the lagoon channel is formed in the same way as a lagoon.

5. That it is not necessary to call in subsidence to explain any of the characteristic features of barrier reefs or atolls, and that all these features would exist alike in areas of slow elevation, of rest, or of slow subsidence.

In conclusion it was pointed out that all the causes here appealed to for an explanation of the structure of coral reefs are proximate, relatively well known and continuous in their action.

THE "COMPTES RENDUS STENOGRAPHIQUES" of the Congress of Geologists, held in the Trocadero Palace during the Exposition of Paris of 1878, has just appeared. It is an octavo volume of over 300 closely printed pages. These include forty memoirs with the related discussions. Seven articles are by Americans—Messrs. Hall, Hunt, Lesley, Cope, Blake and Chamberlin. Among other contributors we notice the names of Daubrée, Favre, Delesse, Lapparent, Barrois, Stephanesco, Rutot, Van den Broek, Ribeiro, Almera, Szabo, etc. Many of the memoirs are of general interest and importance, *e. g.*, *Daubrée* on Experimental studies on fractures of the earth's crust; *Favre* on the effect of folds and lateral twists in geology; *Lapparent* on the plications of the Cretaceous formation between France and England; *Hall* on the nomenclature of the Palæozoic rocks of the United States; *DeMoeller*, the divisions of the Carboniferous; *Cope*, relations of horizons of extinct Vertebrata of Europe and North America; *Jannetaz* on the propagation of heat through rocks; *Hunt* on the Precambrian rocks of North America; *Ribeiro* on the geology of Portugal.

GEOLOGICAL NEWS.—Mr. S. A. Miller, of Cincinnati, is publishing an important series of historical monographs of North American geology. He has concluded the Palæozoic and Mesozoic portions, and is preparing that of the Tertiaries.——Mr. M. E. Wadsworth, of Cambridge, has recently issued in the Bulletin of the Museum of Comparative Zoölogy, a series of full notes on the iron and copper districts of Lake Superior. He gives many graphic sections of vein contacts, explains the stratigraphy and reviews the literature.——Prof. Owen has recently described a new species of Theromorph reptile from the Permian bed of South Africa, under the name of *Platypodosaurus robustus.* The animal nearly resembles some of the Texan forms described by Cope in 1878.——Dr. J. W. Spencer, in the *Canadian Naturalist,* Vol. VIII, describes a number of new Graptolites from the Niagara formation. Four of them are referred to three new genera, *Calyptograpsus, Rhizograpsus* and *Acanthograpsus.*

GEOGRAPHY AND TRAVELS.[1]

THE FRANKLIN SEARCH EXPEDITION.[2]—This expedition, under Lieut. Schwatka, has returned home after a remarkably successful journey to King William Land, and the results of their investigations into the circumstances attending the loss of the memorable British company commanded by Sir John Franklin have been given at length to the world through the columns of the New York *Herald.* Lieut. Schwatka wisely lost no time in looking up the cairn on the Melville peninsula, but set out early in the spring of 1879 on his sledge journey to the scene of the great disaster. Leaving Depot island, in Hudson's bay, on April 1st, they traversed a region previously unvisited by white men, proceeding in a nearly north-westerly direction by the shortest route, to the mouth of Back's river. The party was composed of four white men and thirteen Innuits, with sleds drawn by forty-two dogs. They took with them only about one month's rations, and the success of the expedition is doubtless largely owing to their ability to live on the supplies furnished by the country. Their route should have led them across the Wager river, but at N. lat. 65° 45′ where, according to the charts, they should have been on its banks, nothing could be seen of it. They soon, however, came to an important branch of Back's river, which they followed ninety miles, leaving it near its mouth. Its whole length is 110 to 120 miles. They named it Hayes river in honor of the President. From the tribe living on this stream they heard the same account of the sinking of one of the vessels of Franklin's expedition at a point near O'Reilly's island (N. lat. 63° 30′, W. long. 95°) in the spring of 1849 as was related to Capt. Hall. On May 31st, after visiting Montreal island, they met the

[1] Edited by ELLIS H. YARNALL, Philadelphia.
[2] See NATURALIST for August, 1878, p. 571, and November, 1879, p. 723.

first Neitchillik encampment. Near it on an inlet west of Point Richardson a boat, skeletons and many relics had been found by the natives.

This is believed to be the furthest point reached by the remnant of Franklin's company, and here Lieut. Schwatka also believes the records of the expedition were finally lost, having been contained in a tin box which was broken open by the Esquimaux and its contents scattered to the winds.

Lieut. Schwatka first reached King William Land at the mouth of Pfeffer river, where he visited the cairn erected by Capt. C. F. Hall in May, 1869. On June 15th, the party arrived at Cape Herschell, when they left most of their men in a permanent camp. Cape Herschell was found to be about eighteen or twenty miles further west than it is given on the charts of the Admiralty. Continuing their journey along the coast they discovered the graves of two white men before reaching Collinson's inlet, and at the inlet the camp of Capt. Crozier and his command after abandoning the vessels. They found many relics here and an opened grave, the remains in which were identified by a medal found with them as those of Lieut. John Irving, third officer of the *Terror*. It is probable that Lieut. Irving was conducting a small party back to the ship for provisions after the crews had reached the southern shore of King William Land, and that the men said by the Eskimos to have drifted with the ship to O'Reilly's island, belonged to this return party. Among the ruins of a cairn was found a copy of the record discovered by Lieut. Hobson, of McClintock's expedition in Sir Leopold McClintock's handwriting, and partially illegible. This was the only document found during the journey. McClintock's record buried near the cairn was searched for but not found.

Leaving Irving bay on June 30th, they reached Cape Felix on the 3d of July. No traces of the Franklin expedition were found until three miles south of the cape, where the remains of a permanent camp were seen. A well built cairn or pillar seven feet high on a high hill two miles back from the coast was examined without finding any records. Returning down the coast a careful examination of the country within five or six miles of the coast was made, and at Point Le Vesconte the grave of an officer was found; also in the neighborhood of Erebus bay several skeletons, and in a deep inlet the remains of a very large boat.

Cenotaphs were erected wherever human remains were found. The skeletons were always incomplete and it was not always possible to tell the number of individuals represented in the piles of bones found,

The ice broke up in Erebus bay about the 1st of August. Reaching Terror bay on August 3d, the search was continued along the coast as far west as Cape Crozier, only one skeleton

being found. Lieut. Schwatka remained in King William Land until November 1st, when he started on his return trip to Hudson's bay, pursuing a route south and west of his former course, and following Back's river to 66° N. lat. This stream is laid down on the maps about one degree further west than as found by the travelers. Finding game very scarce near the river, and losing many of their dogs for want of proper food,[1] the party left the river on December 30, 1879, and traveling in a south-easterly direction through a country where plenty of game was found, arrived at Depot island on March 4, 1880.

While in King William Land two of an apparently distinct species of snipe were shot and their skins preserved for deposit in the Smithsonian Institution collection. One of them was distinguished "by a sweet simple song, somewhat similar to a lark, its silvery tones gushing forth as if in perfect ecstacy of enjoyment of sunshine and air, at the same time rising and poising itself on its wings." Small flocks of ducks—the drakes and ducks in separate bands—were also seen. "The drakes are exceedingly pretty, especially about the head and neck. The head is of a pale olive-green hue, a fashionable color in silks a few years ago, and known by the extraordinary name of 'elephant's breath.' This gradually merges into a very pale, warm gray, the line of demarkation between it and the very dark brown which constitutes the general color of the body being very abrupt. The bill is of a vermilion red, and surmounted by a bright orange colored crest with a black border as positively marked as if of black tape." "We often came," says Mr. Gilder, "upon an immense body of drakes sitting upon the edge of an ice floe, looking very much like a regiment of huzzars at a distance drawn up in line of battle. The duck is not so gaudy as her husband. She is quite contented in a full suit of mottled brown and olive-gray, presenting a texture on the back somewhat similar to the canvas back species of Chesapeake bay." Immense herds of reindeer were seen in King William Land in September, but when, about October 1st, the ice became sufficiently strong for them to cross to the mainland, they rapidly disappeared.

It is now shown that the greatest distance traversed by the members of the Franklin expedition was not much over 250 miles. All along this route the Schwatka party found game and supplies in more or less abundance, yet the crews of the *Erebus* and *Terror* evidently died from starvation. As Dr. Hayes remarks, "it does seem strange that 105 men should in so comparatively short a march have been swept out of existence and left no trace by which the history of their expedition can be read."

[1] Twenty-seven died before reaching Depot island.

The temperatures for the following months are given by Mr. Gilder:

1879,	September	mean 21.1°,	minimum 5°	
	October	" 0°	" —38°	
	November	" —23.3°	" —49°	
	December	" —50.4°	" —69°	maximum —2[illegible]
1880,	January	" —53.2°	" —71°	" —23[illegible]
	February	" —44.8°	" —69°	

January was a very stormy month there being only eleven days on which travel was possible, and the total distance passed over in that period, ninety-one miles.

The total distance traveled was 3251 miles, being very much the longest sledge journey in unexplored regions of which we have record. They were also in the field during the entire winter, so that the journey, both in distance and time, is most remarkable. Their dependence upon the resources of the country, much aided, it should be noted, by the excellence of their fire-arms, is also a distinguishing feature of the exploration. To the fact that Lieut. Schwatka and his three companions were able to live on this food is it doubtless owing that they were able to bear with impunity and even with little suffering the great cold to which they were exposed. To their diet and also to their active life throughout the whole year we must attribute their exemption from scurvy, although deprived of lime juice or any of the anti-scorbutics usually taken by similar parties. Probably also his companions possessed, alike with Lieut. Schwatka, the robust health, cheerful disposition and powers of concentration ascribed to him by Mr. Gilder. Certainly the success of this effort to reach this remote land indicate also the existence of strict discipline and thorough organization, the want of which has so often proved fatal to the success of similar attempts at exploration in these desolate regions.

It should be remembered that the results of Lieut. Schwatka's investigations entirely corroborate the statements made by Capt. Hall concerning the fate of the Franklin expedition. And especially is this the case as regards the successful accomplishment of the north-west passage by either the *Erebus* or the *Terror*.

WE REGRET to record the failure of the Howgate expedition, the *Gulnare* having returned home from Disco, being found to be unseaworthy. Dr. Parry, the naturalist of the expedition, remained in Greenland for the winter.

COL. PREJEVALSKY.—In the NATURALIST for May mention was made of the arrival of this distinguished Asiatic traveler in the province of Tsaidam on the northern frontier of Thibet. Further information received at St. Petersburg states that he had previously visited the mountainous region south of Su-chow where two snowy ranges were discovered, to which the names of Hum-

boldt and Ritter were given. He reached Koorlyk, a distance of about 180 miles, without difficulty, but had much trouble in going on to Dzoon Zassak. The distance from Saisan to Dzoon Zassak, at the foot of the Burdan Booda range, is 1370 miles. The whole country traversed, with the exception of occasional oases, is a desert, and forests were found only on the Tien-Shan. Topographical, barometrical and meteorological observations have been made, and accurate data obtained for mapping a large extent of country. From Dzoon Zassak he started for Lhassa, and after being once misled succeeded in crossing the Blue river and reaching the Tan-la plateau where a great snowy chain of mountains attains a height of 16,800 feet.

After driving off a party of nomads who attacked them the expedition reached its furthest point at the village of Nabchu, 180 miles from the capital, permission to visit Lhassa being refused by the Thibetan authorities. The return journey to Tsaidam in the midst of the violent winter storms, was very trying, and took two months. Col. Prejevalsky visited Koko-Nor and finally arrived at Si-ning on March 19th. He hopes to explore the upper course of the Yellow river and return home by way of Urga.

MICROSCOPY.[1]

USE OF COLLODION IN CUTTING THIN SECTIONS OF SOFT TISSUES. —The preparation to be cut being embedded as usual, collodion is applied to the surface of the object by means of a fine brush. The collodion is of the regular strength of the United States Pharmacopœia and should be allowed to settle so as to become as clear as water, and the clear portion decanted and reserved for use. Then after the first cut has been made with the microtome, and the superfluous alcohol removed by means of a piece of clean blotting paper free from ravelings, a small drop of collodion should be taken up with the brush and placed in the center of the object so as to allow it to flow out on all sides to prevent the formation of air bubbles. After being allowed to harden a minute, the section may be cut and placed on the slide with the film of collodion underneath. The advantage in the use of the collodion is that preparations which combine hard and soft tissues or those which are loosely connected, are held in place until the section is removed to the slide, stained and securely mounted.—*Norman N. Mason, Providence, R. I.*

THE ATWOOD CELL.—This new device, intended exclusively for mounting opaque objects, was designed by Mr. H. F. Atwood, of Rochester, and is made in hard rubber by Bausch and Lomb of that city. It consists of a black disc, hollowed at the top to contain the object, and furnished with a rim to receive the cover glass. Those now being made are adapted to half inch covers, and cost thirty cents a dozen. They can be obtained from the

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

inventor or from the dealers in microscopical supplies. The cut gives a sectional view of this cell, the dotted line  indicating the cover glass and the open space below it the location of the object. The glass cover is easily attached by a little shellac or other suitable cement; and the whole cell may be cemented, if desired, to the center of a common glass slide. For convenience of exchanging by post, or for storing a large number of objects for future reference, in a small space, the glass slide may sometimes be omitted altogether, the name or number indicating the object being merely attached to the back of the cell.

ARTIFICIAL CRYSTALS OF GOLD.—In casting bars of pure gold for the manufacture of foil, traces of crystallization may often be observed upon their upper surfaces, and sometimes distinct crystalline forms. These are generally simple triangular faces slightly raised, very similar in appearance to specimens sometimes found in nature. Occasionally several faces of the octohedron may be seen, the edge in some instances being half an inch in length, and quite sharp and well defined. The purer the gold is, the more likely the crystals are to form, and they are oftenest seen when the bars are cast from that which has been previously crystallized by the battery process described below. * * *

The precipitation of gold from solution by the aid of a battery is a well-known process in the common operation of electro-gilding, but to deposit it in the crystalline form is a process of comparatively recent date, having been patented in 1860 as a method of preparing gold for dental purposes. The process is briefly as follows: A solution of chloride of gold and ammonium is placed in a shallow dish coated with heavy gold foil, which is connected with the zinc plate of a large Daniels' battery. Near the top of the solution and connected with the copper plate of the battery, a roll made up of thin strips of pure gold is suspended, enclosed in a muslin bag. The strength of the battery current is controlled by a coil of wire arranged as a rheostat, a clamp terminating one of the battery wires enabling the operator to include a greater or less number of coils in the circuit. The necessary conditions being fulfilled, on completing the circuit the gold is gradually dissolved from the roll and deposited on the bottom of the dish in bright crystalline flakes having the appearance of feathers or fern leaves when examined under the microscope. * * * I have been quite surprised that no trace of faces is to be observed upon these crystals, as is always the case with natural ones. The latter are seen under a low power to be made up of strings of distorted isometric crystals which are often so distinct that they can be measured. The artificial ones do not show this structure, and when magnified to three hundred diameters only show a slightly beaded look along the side ribs, but nothing that can be considered distinct crystalline forms. With the power

mentioned the whole surface of each crystal is in focus at once, showing that the different sets of ribs are in the same plane. Where one crystal lies upon another, when examined under a power of a hundred and fifty diameters, both are in focus at once, showing that they are exceedingly thin and lie perfectly flat. * * *

If a film of amalgam is allowed to form on the surface of a piece of pure gold, and the mercury be then driven off by heat, traces of crystallization may sometimes be observed, a network of indistinct crystals remaining. To accomplish this the gold should be perfectly pure, and the heat applied very gently at first. With the greatest pains, however, the result is not always, or even often, satisfactory. The surface is generally left in an amorphous condition, or at best covered with angular depressions. Very rarely, and under conditions not fully understood, the crystallization is distinct enough to be recognized as such. But distinct though minute crystals of gold amalgam may easily be obtained if the mercury is dissolved out with dilute nitric acid instead of being driven off by heat.—*A. H. Chester in Am. Jour. Sci. and Arts.*

Angular Aperture.—Dr. Geo. E. Blackham's paper on this subject, read at the Microscopical Congress at Indianapolis, has been published by the Industrial Publication Company of New York. The paper presents a comprehensive review, in a popular rather than a mathematical style, of the subject of the angular aperture of microscopic objectives. It is neatly published in an attractive form, and extensively illustrated with optical diagrams. and it will be a convenient and welcome addition to the libraries even of those most familiar with the somewhat trite subject.

Sweating of Microscopic Slides.—Not long ago a well-known optician showed to me a spoiled "podura" slide. The scales were very good and large—in fact, it was a slide which I had given to him, and it had been selected by myself in Beck's establishment in London as unexceptionally fine. This slide began slowly to show symptoms of "sweating." One scale after another appeared as though moisture had, in some mysterious way, penetrated to the objects; it was not water, however, for when the cover, after much trouble, had been removed, and warmed sufficiently to evaporate anything like water, the scales still exhibited the same appearance, and, in fact, the heat required to get rid of this apparent moisture was so great that the scales were charred. When wax rings are used, this apparent wetting or "sweating" occurs quickly, and more disagreeable than this, innumerable elongated specks, possibly crystalline, appear all over the under surface of the cover-glass. The same trouble occurs when any of the ordinary asphalt preparations are used and the only cement which I have thus far found to be tolerab

successful is shellac thoroughly incorporated with the finest carbon (diamond black) such as is used in the preparation of the best printing inks; the solvent being alcohol, these rings dry rapidly, and the cover is attached by heating. Even these rings cannot be trusted unless thoroughly dry, and spontaneous drying is better than baking. I have had preparations spoiled after mounting on asphalt rings which had been made for over a year, and which had been subjected for several hours to the heat of a steam bath. With large, somewhat coarse objects, the defect is not so marked, but with delicate ones, and especially test objects, it is simply a nuisance. With care I think the shellac rings may answer pretty well. I have not tried the aniline colored rings. The moisture (whatever it is) and the crystalline specks appear to be derived from the vaporizable parts of the wax or cement given off under conditions where one would suppose such a thing impossible; it is however a fact; I have the proof of it, and I dare say hundreds of others have, too plainly evident. There is another mode of making cells which promises well for permanence. My attention was first called to this method by Dr. Tulk, of London, who suggested for this purpose the thin gutta-percha tissue used by surgeons in the place of oiled silk. I have had special punches made which cut neat rings from this tissue, and I have used these rings with the greatest satisfaction. I have no preparation of my own more than two years old, these, so far, show no signs of change. Dr. Tulk informs me that he has them ten years old, and still good as when new. I have noticed that in some recent papers in the microscopical journals the writers who, with little experience, have so lauded wax rings, speak of "thin rubber" for rings. Evidently they have seen somewhere the gutta-percha mount, and supposed it rubber—the latter will not answer, melted rubber will not become hard. One beauty of the gutta-percha ring is the very moderate heat required; it is thus available for many objects which might be injured by the greater heat necessary for the asphalt or shellac rings. As these rings, the arrangement of which I have spoken of, can be rapidly made, and as they can be kept for any length of time (shut away from the dust), they are at any moment ready as well as convenient for use. The preparation is first arranged, dried or burnt on the cover, the slide cleaned, a ring laid on the center, and on this the cover is placed; the whole is now held together by the forceps and *slightly* warmed, just sufficient to soften the gutta-percha; the forceps may now be laid aside, or used simply to press the cover home, warming the slide gently, also the cover; the perfect contact of the softened "tissue" with the cover and slide is easily recognized, and with a little care this can be effected very quickly, and nothing further is necessary. A finishing r of colored cement makes a very neat mount, but it is not n sary.—*Prof. H. L. Smith, in "Science."*

SCIENTIFIC NEWS.

— The fiftieth meeting of the British Association for the Advancement of Science was held at Swansea, beginning August 26th. The inaugural address of the president, Prof. A. C. Ramsay, was on the recurrence of certain phenomena in geological time. It was a contribution to the doctrine of uniformitarianism. He claimed that the deposition of the Laurentian rocks took place far from the beginning of recognized geological time; that the phenomena of metamorphism extend from that date all through the later formations down to and including part of the Eocene strata; that volcanic forces played no more important part in any period of geological time than in our modern epoch, that the formation of mountain chains has gone on with increasing vigor from before the deposition of Silurian rocks to Pliocene times; that the deposition of salts from aqueous solutions in inland lakes and lagoons appears to have taken place through all time; that glacial phenomena began with the Cambrian epoch. He concludes, therefore, that the earliest of the physical events alluded to by him were so enormously removed from the primitive events assumed by the nebular hypothesis, "that they appear to me to have been of comparatively quite modern occurrence, and to indicate that from the Laurentian epoch down to the present day all the physical events in the history of the earth have varied neither in kind nor in intensity from those of which we now have experience." The address of H. C. Sorby, president of the section of geology, was on the comparative structure of artificial slags and erupted rocks, there being a gradual passage from one type to the other. The address of Dr. Günther, president of the section of biology, was on museums, with especial reference to the British Museum. The address of Mr. Balfour in the department of Anatomy and Physiology, was on recent progress in embryology, and is a valuable résumé of our present knowledge of the origin of the different anatomical systems of the animal body, with especial reference to the genesis of the nervous system.

— A London paper of recent date gives the following particulars of an extraordinary match at rat killing. "Hollinwood, near Manchester, was the scene of a rather novel rat-killing match the other day, between Mr. Benson's fox terrier dog, Turk, and a Mr. Lewis's monkey, for £5. The conditions of the match were that each one had to kill twelve rats, and the one that finished them the quickest to be declared the winner. You may guess what excitement this would cause in the 'doggy' circle. It was agreed that Turk was to finish his twelve rats first, which he did, and in good time, too, many bets being made on the dog after he had finished them. After a few minutes had elapsed it now cam the monkey's turn, and a commotion it caused. Time bei called, the monkey was immediately put to his twelve rats, I

inventor or from the dealers in microscopical supplies. The cut gives a sectional view of this cell, the dotted line  indicating the cover glass and the open space below it the location of the object. The glass cover is easily attached by a little shellac or other suitable cement; and the whole cell may be cemented, if desired, to the center of a common glass slide. For convenience of exchanging by post, or for storing a large number of objects for future reference, in a small space, the glass slide may sometimes be omitted altogether, the name or number indicating the object being merely attached to the back of the cell.

Artificial Crystals of Gold.—In casting bars of pure gold for the manufacture of foil, traces of crystallization may often be observed upon their upper surfaces, and sometimes distinct crystalline forms. These are generally simple triangular faces slightly raised, very similar in appearance to specimens sometimes found in nature. Occasionally several faces of the octohedron may be seen, the edge in some instances being half an inch in length, and quite sharp and well defined. The purer the gold is, the more likely the crystals are to form, and they are oftenest seen when the bars are cast from that which has been previously crystallized by the battery process described below. * * *

The precipitation of gold from solution by the aid of a battery is a well-known process in the common operation of electro-gilding, but to deposit it in the crystalline form is a process of comparatively recent date, having been patented in 1860 as a method of preparing gold for dental purposes. The process is briefly as follows: A solution of chloride of gold and ammonium is placed in a shallow dish coated with heavy gold foil, which is connected with the zinc plate of a large Daniels' battery. Near the top of the solution and connected with the copper plate of the battery, a roll made up of thin strips of pure gold is suspended, enclosed in a muslin bag. The strength of the battery current is controlled by a coil of wire arranged as a rheostat, a clamp terminating one of the battery wires enabling the operator to include a greater or less number of coils in the circuit. The necessary conditions being fulfilled, on completing the circuit the gold is gradually dissolved from the roll and deposited on the bottom of the dish in bright crystalline flakes having the appearance of feathers or fern leaves when examined under the microscope. * * * I have been quite surprised that no trace of faces is to be observed upon these crystals, as is always the case with natural ones. The latter are seen under a low power to be made up of strings of distorted isometric crystals which are often so distinct that they can be measured. The artificial ones do not show this structure, and when magnified to three hundred diameters only show a slightly beaded look along the side ribs, but nothing that can be considered distinct crystalline forms. With the power

mentioned the whole surface of each crystal is in focus at once, showing that the different sets of ribs are in the same plane. Where one crystal lies upon another, when examined under a power of a hundred and fifty diameters, both are in focus at once, showing that they are exceedingly thin and lie perfectly flat. * * *

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June 29.—Dr. Allen on Bunodont teeth. Dr. Foote on caverns near Louray, Va.

July 27.—Mr. Edw. Potts made some remarks on sponges.

August 3.—Mr. Potts on larva of flies. Mr. Meehan spoke on "sleep of plants."

September 7.—Dr. Herman Evarts spoke on Infusoria. Dr. Foote on a large specimen of Sphene. Mr. Potts on Plumatella.

September 14.—Dr. Evarts spoke on Infusoria and described *Freia cærulea*. Mr. Meehan on the limit of vegetation in the Rocky mountains. Mr. Potts on tubers. Mr. Meehan on nesting of birds.

September 21.—Dr. Leidy spoke on organic remains discovered in Hartman's cave. Prof. Porter on organic life and vegetation. Mr. Meehan on dimorphism in plants.

The following papers have been presented for publication: March 16.—"Carcinological Notes, No. IV," by J. S. Kingsley. March 23.—"On the Gestation and Generative Apparatus of the Elephant," by Dr. H. C. Chapman. "On a new species of Hemitripterus from Alaska," by W. N. Lockington. April 13.—Description of a new species of Catostomus (*C. cypho*) from the Colorado river," by W. N. Lockington. May 18.—"On the Structure of the Orang-outang," by Dr. H. C. Chapman. June 1.—"Description of a Partula, supposed to be new, from the Island of Moorea," by W. D. Hartmann, M.D. June 8.—"On the development of *Lemna minor*," by Wm. Barbeck. June 15.—"A bibliographical catalogue of the genus Partula, with observations on the species," by W. D. Hartmann, M.D. August 17.—"Rhizopods in the mosses of the summit of Roan mountain, N. C.," by Jos. Leidy, M.D.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

Zeitschrift fur wissenschaftliche Zoologie.—July 30. On a peculiar formation of the dorsal vessel in some Ephemerid larvæ, by O. Zimmermann. Contributions to a knowledge of the Gephyrea, by J. W. Spengel.

The Geological Magazine.—September. Oceans and Continents, by T. M. Reade. The mammoth in Siberia, by H. H. Howorth.

Jenaische Zeitschrift fur Naturwissenschaft.—August 15. On the structure of the Ctenophora, by R. Hertwig (an elaborate histological essay with six plates). On the doctrine of cell structure, by C. Frommann.

Annales des Sciences Naturelles.—June, July. Anatomical researches on the Bullidæ, by M. Vayssière (an elaborate and well illustrated treatise on these mollusks).

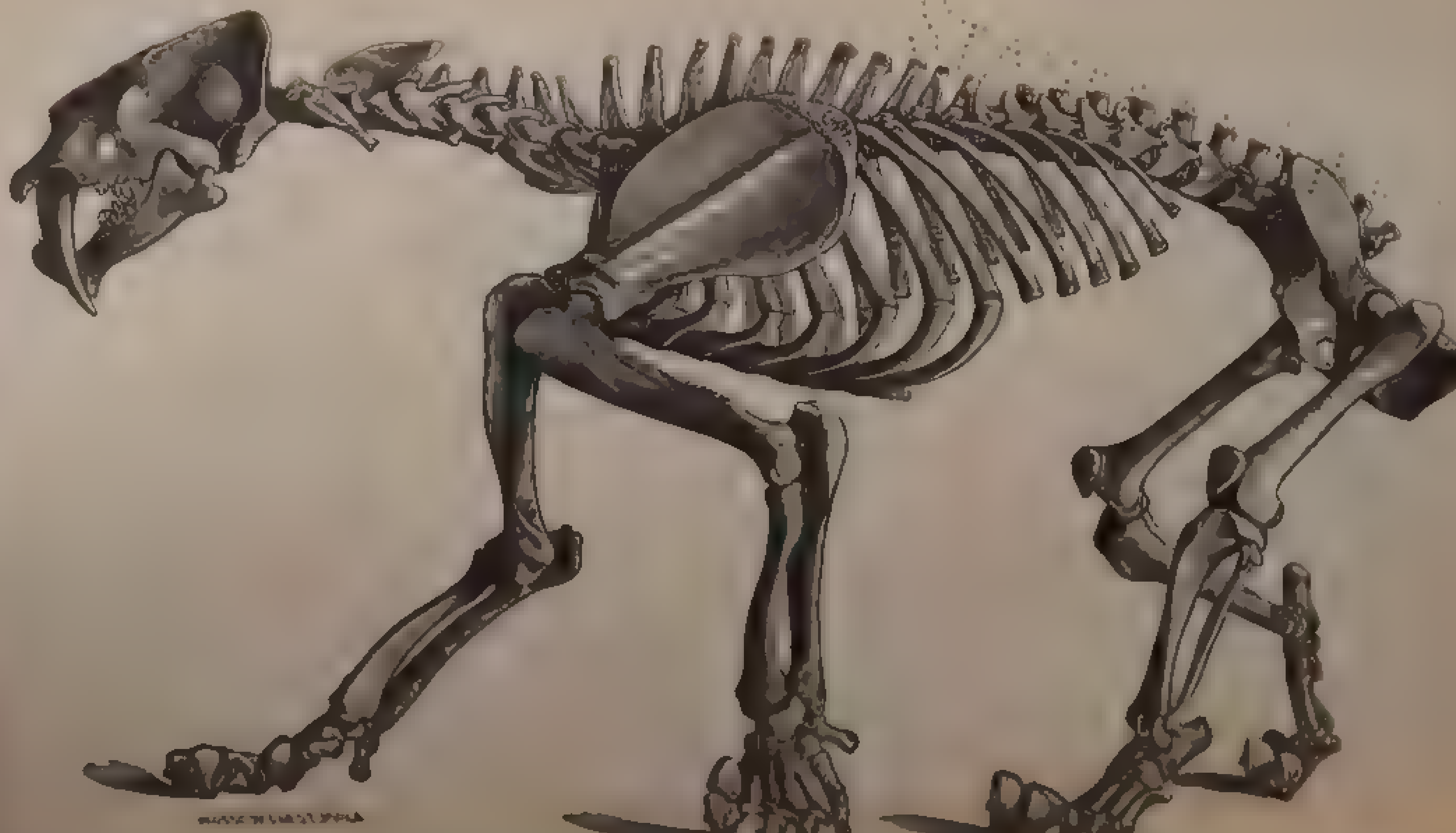

FIG. 18.—*Smilodon necator* Gervais, less than one-ninth natural size. (From Illustrated [illegible])

THE

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ON THE EXTINCT CATS OF AMERICA.

BY E. D. COPE.

IN following the general series of the *Carnivora*, we pass, as in other orders, from the generalized to the specialized types. That we should begin with the *Procyonidæ* (raccoons) and their allies, is indicated by all the characters to be especially considered in the case. They have five toes on all the feet and are plantigrade, resembling in these points all primitive *Mammalia*.[1] They have the original number of molar teeth, seven on each side, and of these none are distinctly developed sectorials. The condyloid and carotid foramina are distinct, and there is a postglenoid foramen. If, starting from this point of departure, we arrange the succeeding families of *Carnivora* according to their resemblances and differences in these respects, we have a tolerably consecutive series of divisions.

Passing at present over the families *Mustelidæ*, *Viverridæ*, *Cryptoproctidæ* and others, with five toes on all the feet, we reach those in which the hind foot has lost a digit, leaving the number 5—4. These are the *Protelidæ*, *Canidæ* and *Felidæ*. We can take but one step further in this order, that is, to those species where the anterior foot has also lost a toe, which constitute the family *Hyænidæ*. The toes are therefore here 4—4. For the well-marked characters of the three families mentioned just before, I refer to another page, and proceed to define, briefly, the division which has been heretofore termed the *Felidæ*. In doing so I am compelled to omit several of the characters generally employed

[1] See Homologies and Origin of Types of Molar Teeth of *Mammalia educabilia*. Academy Phila., 1874, March.

to define that family, since I have found them to be wanting from various extinct genera. The only comprehensive definition which I can give is the following:

Digits 5—4. Sectorial teeth well developed in both jaws; not more than one true molar tooth in the upper, nor more than two true molar teeth in the lower jaw. Glenoid cavity grasping mandibular condyle anteriorly as well as posteriorly.

Prof. Gill, who has devoted much attention to the definition of the families of the *Mammalia*,[1] gives the following skeletal characters in his diagnoses of the *Felidæ* and of the three comprehensive divisions within which he places it. "I. Skull with the paroccipital process applied closely to the auditory bulla; the mastoid process small or obsolete; external auditory meatus very short or imperfect. Div. A. Carotid canal minute and superficial or obsolete; condyloid foramen and foramen lacerumposticum debouching into a common fossa; glenoid foramen minute or null. Os peuis rudimentary. Subdiv. 1. Otic bulla divided by a septum into posterior and anterior chambers communicating by a narrow aperture (Flower). Subdiv. a. Skull with no alisphenoid canal." All of the parts here mentioned I have found to be important in the definition of the natural divisions of the *Carnivora*, excepting those derived from the paroccipital and mastoid processes. But their condition in the extinct *Carnivora* which have been hitherto arranged with the *Felidæ*, and which resemble them very much in superficial characters, does not coincide with Prof. Gill's definition. Thus in the various American genera which resemble *Drepanodon*, the carotid canal is distinct from the *foramen lacerum posterius*, and the condyloid foramen is also separated from it by quite a space. These are characters which belong to most of the *Carnivora* with five digits on all the feet. Further, the postglenoid and postparietal foramina are present, also characters of the lowest *Carnivora*, as the bears and certain extinct dogs. Then there is an alisphenoid canal, which is also found in bears, dogs and the cat-like *Cryptoprocta*. I cannot demonstrate that the otic bulla is divided as the above diagnosis requires, in any of the fossil species. I have verified the above characters on species of the following genera, of which I have well preserved skulls; *Archælurus*, *Nimravus*, *Dinictis*, *Pogonodon*,[2]

[1] Arrangement of the Families of Mammals. Smithson. Miscell. Coll., 230, 1872. p. 56.

[2] Except those of the base of the skull.

supposed to have foundered at sea, was Dr. E. L. Moss, a good observer of nature, who contributed some excellent papers on marine animals to the publications of English scientific societies, and withal was an excellent artist.

— Augustin Seguin and Jules Luquet, two eminent civil engineers from Lyon, France, are now visiting the Yellowstone National Park. Within two years a railroad will be completed which will render this park very accessible.

— A list of preparations of Phylloxera, its natural enemies and of other insects living on the vine, has been published by Dr. Adolph Blankenhorn, of Karlsruhe.

— The Italian Government has recently made the liberal appropriation of 1,000,000 lire for a Geological Survey of Italy.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Academy of Natural Sciences, Philadelphia, March 16.—Mr. J. A. Ryder described *Trichopetalum lunatum*, and spoke on Podophrys and Epistylus; he also described *Camaraphysema obscura*. Mr. Potts spoke on Vorticella.

March 23.—Dr. H. C. Chapman remarked on the generative apparatus of Elephas. Mr. Ryder described a new order of myriapods, Symphyla.

March 30.—Mr. Ryder spoke farther on Symphyla. Mr. Meehan on advancement of vegetation. Dr. H. Allen on the olfactory sense in mammals. Mr. Ryder on Epistylis. Mr. Potts on Vorticella.

April 13.—Dr. Jos. Leidy remarked on Entomostracans and Infusoria in ponds near Woodbury, N. J. Mr. Meehan on Sarcodes.

April 20.—Mr. J. S. Kingsley spoke on cell division.

April 27.—Mr. H. C. McCook remarked on honey ants. Mr. Jos. Willcox on the habits of the blue heron.

May 4.—Mr. McCook remarked on honey ants. Mr. Isaac Martindale on parasitic plants. Mr. Potts on Spongilla.

May 11.—Prof. Pike spoke on fossil impressions supposed to have been made by jelly fishes. Mr. Ford on eggs of mollusks.

May 18.—Dr. Chapman spoke on the anatomy of the orang-outang. Messrs. Ford and Potts on the nidus of Natica.

May 25.—Dr. A. J. Parker spoke on the brain of the chimpanzee.

June 1.—Mr. J. A. Ryder described a species of Japyx. Prof. S. S. Haldeman spoke on stone implements. Mr. Edw. Potts remarked on the embryo of Natica.

June 8.—Dr. Francis Dercum spoke on the lateral lines in fishes. Mr. E. Potts on the anatomy of pipe fish.

Descending the scale the number of molar teeth increases at both ends of the series in the lower jaw, and anteriorly only in the upper, the number of the true molars never exceeding $\frac{1}{2}$. The following table gives the definitions of the genera. I am unfortunately ignorant of the characters of the foramina in *Proælurus* and *Pseudælurus*, as well as in *Ælurogale* and *Eusmilus*.

I. Lateral and anterior faces of mandible continuous; no inferior flange.

a. No anterior basal lobe of superior sectorial; inferior sectorial with a heel; canines smooth.

Molars $\frac{4}{4}$ $\frac{1}{2}$; inferior sectorial with interior tubercle.......... *Proælurus*.
Molars $\frac{3}{3}$ $\frac{1}{1}$; inferior sectorial without interior tubercle...... *Pseudælurus*.

II. Lateral and anterior faces of mandibles separated by a vertical angle; no inferior flange; incisors obspatulate.

a. No anterior basal lobe of superior sectorial; inferior sectorial with a heel (and no internal tubercle); incisors truncate.

Molars $\frac{4}{3}$ $\frac{1}{2}$; canine smooth.............................. *Archælurus*.
Molars $\frac{3}{3}$ $\frac{1}{2}$; canine denticulate......................... *Ælurogale*.
Molars $\frac{3}{2}$ $\frac{1}{2}$; canine denticulate......................... *Nimravus*.

III. Lateral and anterior faces of mandible separated by a vertical angle; an inferior flange; incisors conic, canines denticulate.[1]

a. No or a small anterior basal lobe of superior sectorial;[2] inferior sectorial with a heel. No posterior lobes of the crowns of the premolars.

Molars $\frac{3}{3}$ $\frac{1}{2}$.. *Dinictis*.
Molars $\frac{3}{3}$ $\frac{1}{1}$.. *Pogonodon*.
Molars $\frac{2-3}{2}$ $\frac{1}{1}$.. *Hoplophoneus*.
Molars $\frac{?}{1}$ $\frac{?}{1}$.. *Eusmilus*.

It is readily perceived that the genera above enumerated form an unusually simple series, representing stages in the following modifications of parts: (1) In the reduced number of molar teeth. (2) In the enlarged size of the superior canine teeth. (3) In the diminished size of the inferior canine teeth. (4) In the conic form of the crowns of the incisors. (5) In the addition of a cutting lobe to the anterior base of the superior sectorial tooth. (6) In the obliteration of the inner tubercle of the lower sectorial; and (7) in the extinction of the heel of the same. (8) In the development of an inferior flange and lateroanterior angle of the

[1] Gervais' figures of the canines of *Eusmilus bidentatus* represent no denticulations, but the figure is not clear.

[2] Rudimental in *Hoplophoneus*.

front of the ramus of the lower jaw. (9) In the development of cutting lobes on the posterior borders of the larger premolar teeth.

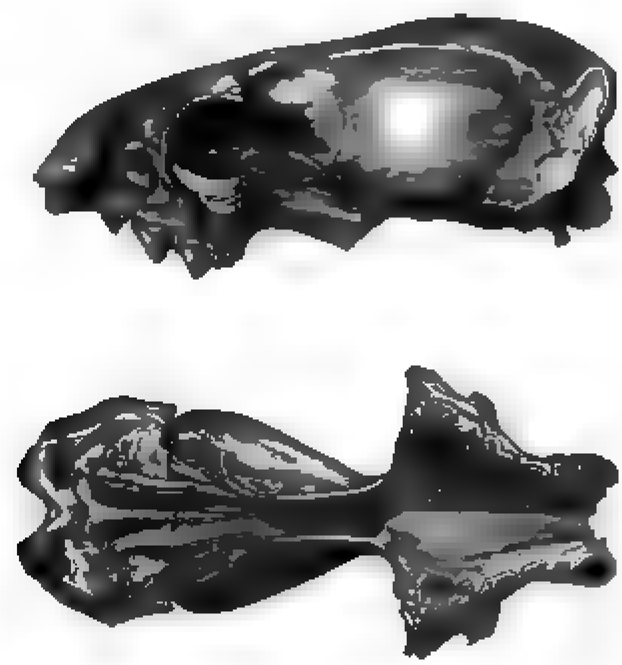


FIG. 1.—*Proælurus julieni* Filh.; two-thirds nat. size. From Filhol.

(1) The reduction in the number of molar teeth. The dental formula of *Proælurus* is that of some *Viverridæ* and *Canidæ*, and the reduction from this point to the end of the series is obvious. In *Eusmilus*, as in *Smilodon*, the number of molars is less by one in the inferior series, than in *Lynx* and *Neofelis*, where the formula is the smallest known among *Felidæ* proper, viz: $\frac{2}{2}$ $\frac{1}{1}$. (2) The enlarged size of the superior canine teeth. In *Proælurus* and *Pseudælurus*, the canines of both jaws are subequally developed as in recent *Felidæ*. In *Archælurus* the superior is the larger, but does not, relatively to the molars, exceed that of *Felis*. It is rather compressed in form, and has a sharp cutting edge posteriorly. In *Nimravus* the superior canine begins to have the enlarged size of the sabre-tooths, but its form is peculiar in the *N. gomphodus*, being spike-shaped rather than sabre-shaped. We find the true sabre-shape first in *Dinictis*, where it is compressed, and with a denticulate cutting edge on both front and rear. In *Pogonodon* it has reached a very large size, and it does not display much increase in this respect until we reach the last genus of the series,

FIG. 2.—*Proælurus julieni* Filh.; two-thirds nat. size; *a* inner view of mandible; *b* superior view of inferior teeth; *c* inferior sectorial, natural size. From Filhol.

Eusmilus, where its proportions are enormous; almost as large as in the feline genus *Smilodon*, where they appear to have been an inconvenience to the animal. (3) The diminished size of the inferior canines becomes evident in the lower genera of the third division (supra) of the *Nimravidæ*, but is most decided in the highest genera *Hoplophoneus* and *Eusmilus*. (4) The incisor teeth have the usual obspatulate or obovate outline in the genera of the first and second divisions of the family, including *Nimravus*. They are conic in the true sabre-tooths with flared lower jaw, beginning with *Dinictis* and ending with *Eusmilus*. (5, 6 and 7) The structure of the sectorials. The presence of a heel and an inner tubercle of the lower sectorial are well known characters of a majority of the *Carnivora*. In only the most highly organized genera are they wanting, and among them are included all those of the *Felidæ* that still exist. In the *Nimravidæ* the inferior genera have both in a reduced degree, and they soon disappear as we ascend the scale. Thus the inner tubercle is only present in the species of *Proælurus*, *Dinictis* and *Hoplophoneus*. The heel on the other hand remains throughout the entire family. The anterior basal lobe of the superior sectorial has the same history, its absence being characteristic of the inferior *Carnivora*, and of all the genera of *Nimravidæ*, except in *Hoplophoneus*, where it is rudimental. It is well developed in *Drepanodon*, as in recent *Felidæ*, and is double in *Smilodon neogaeus*. (8) The development of the inferior flange and lateroanterior angle of the mandibular ramus. There is a successive advance in the development of these characters, beginning with the second group, for in the first they are wanting. The lateroanterior angle is developed in *Archælurus* and allied genera, and is merely continued on the inferior border of the ramus. In the third group it is much more acute, and is deflected downwards, forming the well known flange of the sabre-tooths. It is longest in the *Eusmilus bidentatus* Filh. (9) The highest genera of *Nimravidæ*, e. g. *Hoplophoneus*, differ from the true *Felidæ*, in the absence of the cutting lobes on the posterior edges of the crowns of the larger premolar teeth. But according to Filhol these lobes are present in the generalized genera, *Proælurus* and *Pseudælurus*, which are thus brought into a relation with the *Felidæ*, not possessed by other *Nimravidæ*.

A characteristic perfection of the *Felidæ* is seen in the genus *Smilodon*; that is, the vertical direction of the ungual phalanges, by

which the claws become retractile. This is well displayed by the two splendid specimens of *Smilodon necator* from Buenos Ayres, which have been preserved (See Fig. 12). Unfortunately, these phalanges have not yet been discovered in any species or the *Nimravidæ*, and it is not yet certain what their structure really was. Among the true *Felidæ*, the genus *Cynælurus* displays a less degree of development in this respect than the other genera, the ungual phalanges lacking the proximal process below the articular facet. Such a condition is to be looked for among the less perfect genera of *Nimravidæ*.

The succession of genera above pointed out coincides with the order of geologic time very nearly. Those belonging to groups first and second, belong to the lower and middle Miocene, except *Ælurogale*, which is perhaps upper Eocene, and *Pseudælurus*, which is middle Miocene. The genera of the first group of division third, have the same lower Miocene age, except *Eusmilus*, which has been found in the same formation (Phosphorites) as the *Ælurogale*.

The relations of these genera are very close, as they differ in many cases by the addition or subtraction of a single tooth from each dental series. These characters are not even always constant in the same species, so that the evidence of descent, so far as the genera are concerned, is conclusive. No fuller genealogical series exists than that which I have discovered among the extinct cats.

As to the phylogeny of this family, there are flesh-eaters of the Eocene period which may well have been the ancestors of both the *Nimravidæ* and *Felidæ*.[1] I have suggested that this position is most appropriately held by the *Oxyænidæ*, a family of several genera, which included the most formidable rapacious mammals of that early period in both continents. The interval between them and the *Nimravidæ* is however great, for in the *Oxyænidæ* when there is a sectorial tooth of the upper jaw, the first true molar is utilized instead of the last premolar; and the second true molar below is a sectorial as well as the first. Several intervening forms must yet be found to complete the connection, if it have ever existed. It is, however, very likely that the true *Felidæ* were derived from the genus *Proælurus* through *Pseudælurus*, if indeed these two genera be not the primitive members of that family, for as above

[1] See, On the genera of the *Creodonta*, by E. D. Cope, Proceed. Amer. Philos. Soc. July, 1880.

remarked, the evidence of their possession of the characters of the *Nimravidæ* has not yet been obtained. There can be no reasonable doubt that the genera *Drepanodon* and *Smilodon* in the *Felidæ* are the descendants of *Hoplophoneus* and allied genera. In fact, the *Nimravidæ* and *Felidæ* are "homologous groups," having corresponding terms in the manner I foreshadowed as a general principle in 1868 (Origin of Genera).

In looking for causes in explanation of the modifications of structure cited, one can easily discover that there is a close relation between the arrangement of the teeth and the mechanical laws involved in the performance of their function, those of seizing an active prey, and of cutting up their carcasses into pieces suitable for swallowing. It is obvious that in the latter case the flesh teeth bear the resistance, and the masseter muscle is the power, and that the nearer these parts are together, the better is the function performed. As a matter of fact, the sectorial teeth in modern carnivora are placed exactly at the angle of the mouth, which is the front border of the masseter muscle.

In the process of evolution both the muscle and the teeth have moved forwards in connection with the shortening of the jaw behind. This has been due to the necessity of bringing the power (masseter) nearer to another point of resistance, viz: the canine teeth.

In the early carnivores (as Hyænodontidæ) the long jaws supported more numerous teeth ($\frac{4-3}{4-3}$) than in any modern families, and the fissure of the mouth was probably very wide, as the last molar was a sectorial. The canine teeth were evidently very ineffective weapons. The animals probably only snapped with their jaws, and did not attempt to lacerate or hold on, as do the cats.

The dogs of to-day are long jawed, and they snap in a manner quite distinct from anything seen among the cats. The only dogs that hold on are the short jawed bull-dogs.

So in the use of the canines we have the ground of the shortening of the jaw behind and before, and the consequent change of structure which resulted in the modern perfected *Felidæ*.[1]

The following list shows the number and distribution of the species of the *Nimravidæ*:

[1] See AMERICAN NATURALIST, 1878, p. 171.

	Upper Eocene.	Lower Miocene.		Upper Miocene.		Pliocene.	
	Eur.	Eur.	Am.	Eur.	Am.	Asia. Eur.	Am.
Proælurus julieni Filh		×					
" lemanensis Filh		×					
Pseudælurus hyænoides Blv				×			
" edvardsi Filh	×						
" intrepidus Leidy					×		
" sivalensis Lydd						×	
Archælurus debilis Cope			×				
Ælurogale intermedia Filh	×						
" "acutata Filh."[1]							
Nimravus gomphodus Cope			×				
" confertus Cope			×				
Dinictis felina Leidy			×				
" cyclops Cope			×				
" squalidens Cope			×				
Pogonodon platycopis Cope			×				
" brachyops Cope			×				
Hoplophoneus oreodontis Cope			×				
" primævus Leidy			×				
" occidentalis Leidy			×				
" cerebralis Cope			×				
Eusmilus bidentatus Filh	×						

We may now consider in more detail the characters of the genera and species of North America.

Division I. The Primitive Cats.

PSEUDÆLURUS Gervais. Although this genus commences in the Phosphorites of France, which are generally referred to the upper Eocene, it has at least some dental characters of the true *Felidæ*. Even at that early period, if well defined period, it be,[2] the premolar teeth are lobed; see *P. edvardsi* Filhol. The single American species, the *P. intrepidus* Leidy is from a late Miocene formation, the Loup Fork. It is only known from lower jaws, of which Dr. Hayden procured one in Nebraska, and the writer another in Colorado. It was a species with large teeth, of about the size of the Canada lynx.

Division II. The False Sabre-tooths.

ARCHÆLURUS Cope.

This genus is of interest as completing the connection between the sabre-tooth and primitive unspecialized groups of the cats, a transition also clearly indicated by the genus *Nimravus*. In den-

[1] I only know this species by name.

[2] The Phosphorites are suspected by some to contain mixed materials from different horizons.

tition it adds a tooth to the number belonging to that genus, in both jaws, and has a smooth-edged canine; it is otherwise identical with that genus, unless, indeed, the exostosis supporting the inferior sectorial tooth in the *A. debilis*, be introduced into this category; a position I am not prepared to assume positively. There is but one species known, the

Archælurus debilis Cope.

It is probable that this was an animal presenting much the appearance of the existing cats, and of about the size of the American panther. Omitting more technical characters, it differed from this and other species of the *Felidæ* in the greater slenderness of its feet. Its head was characterized by less breadth through the posterior part of the cheeks, and by a greater convexity of the forehead between the eyes, and a greater prolongation backward of the same region.

Its structure plainly indicates that this species was of less sanguinary habits than the existing *Felidæ*, since its prehensile organs, both of the feet and dentition, are less robust. The slender zygomata and rami of the lower jaw show also that the impact of its bite was less powerful, although the large size and narrow form of the sectorial teeth, furnish an effective cutting apparatus, which in some degree supplements the deficiency of strength. The weakness of the rami is further provided against

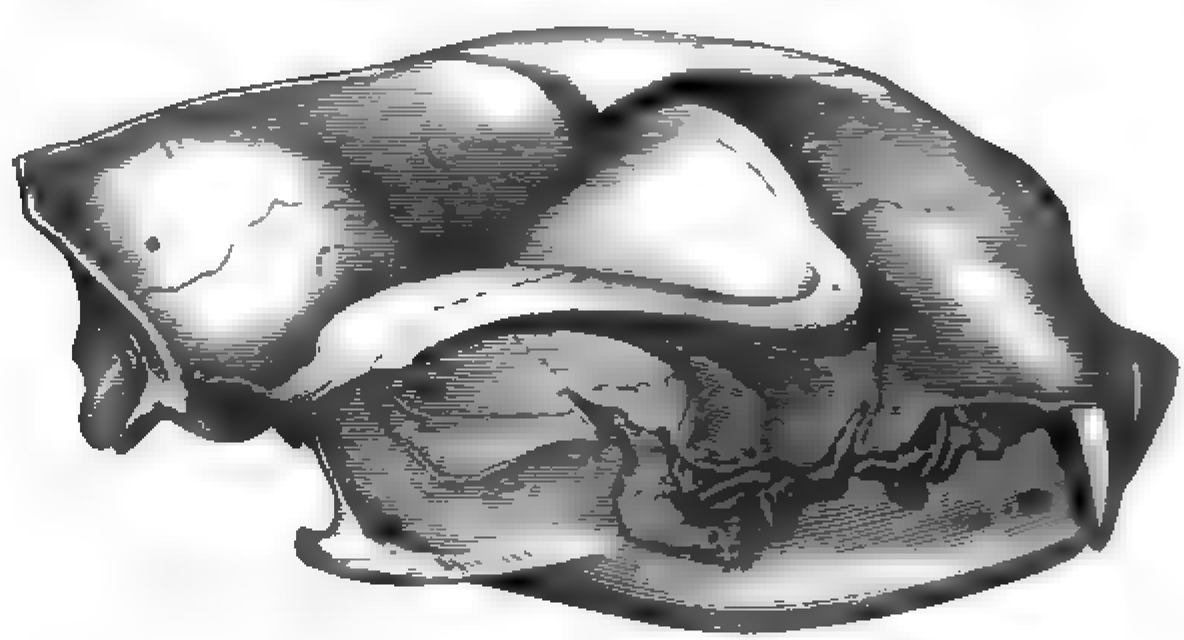


FIG. 3.—*Archælurus debilis*, one-half natural size. Mus. Cope. From Vol. ɪv, Report of U. S. Geol. Surv. Terrs.

by the curious exostosis at the base of the inferior sectorial, already mentioned; see Fig. 3.

The first description of this species was given by myself under the head of the *Nimravus brachyops (Machærodus brachyops*. Palæontol. Bulletin, 30, p. 10, Dec., 1878), from a skull found by

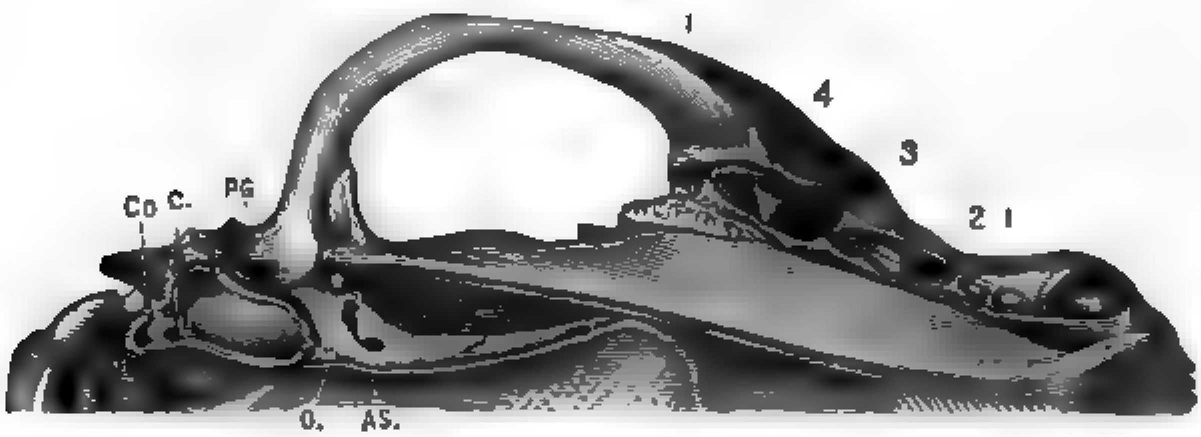


FIG. 4.—*Archælurus debilis*, one-half nat. size; inferior aspect of Fig. 1. Foramina: AS, alisphenoid; O, ovale; PG, postglenoid; C, carotid; Co, condylar.

Mr. Sternberg, under the impression that it might belong to a female of that species. Subsequently a nearly perfect cranium. obtained by Mr. Wortman, demonstrated the distinctness of the animal both as to species and genus.

Horizon and Locality. The remains of the *Archælurus debilis* have so far been only found in the Truckee Miocene formation of the John Day river, Central Oregon. Judging from the remains, it was, after the *Nimravus gomphodus* the most abundant feline of that region.

NIMRAVUS Cope.

This genus has the dental formula and characters of *Hoplophoneus*, with the addition of a tubercular inferior molar tooth. It is, moreover, not a true sabre-tooth, as is that genus, since it does not display the inferior anterior flange of the mandible. This is represented by an obtuse angular border, quite as in the species of *Archælurus*, in which genus *Nimravus* finds its nearest ally. The constant absence of the anterior premolars in both jaws distinguishes it sufficiently from that genus. On this account, and in view of the larger development and denticulated edge of the superior canine teeth, *Nimravus* may be considered as occupying a position between the two genera above named.

Two species are known to me, a larger and a smaller, both from the Middle Miocene formation.

Nimravus gomphodus Cope.

The *Nimravus gomphodus* is as large as the full-grown panth of the large varieties. It probably stood high above the ground, but whether the bo had the elongate proportions of that anim or the more robust form of the leopard a jaguar, cannot be ascertained in the absen of necessary material. Unless the animal h pendulous upper lips, a thing unknown amo cats, the superior canine teeth must ha been distinctly displayed on each side of t chin; their points descending entirely bel the lower margin of the lower jaw, when t mouth is closed. As these points are less co pressed than in the true sabre-tooths, th were less liable to fracture from lateral blo but were more apt to be broken by fore-and- strains, owing to their slenderness.

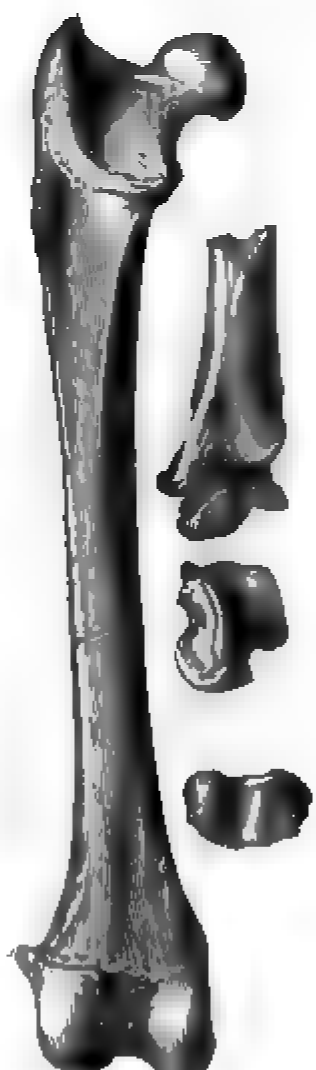


FIG. 6. FIG. 5.

FIG. 5.—End of tibia and astragalus of *Archælurus debilis*. FIG. 6.—Femur of *Nimravus gomphodus*. All one-third natural size. Mus. Cope.

The long canines of this species testify blood-thirsty habits, for as weapons for pe trating wounds they are without rival amo carnivorous animals. They resemble conside ably the teeth of some of the *Dinosauria*, f instance, those of the Triassic *Clepsysaur* The sectorial apparatus is especially effecti and no tissue could long resist the combin action of the opposing blades of the two jaw Nevertheless this species did not, probably, a tack the large *Merycochœri* of the Oregon he bivores, for their superior size and powerf tusks would generally enable them to resist an enemy of the s of this species. They were left for the two species of *Pogonodo* who doubtless held the field in Oregon against all rivals. Th compressed mandibular rami of the *Nimravus gomphodus*, thoug less slender than those of the *Archælurus debilis*, are not so we calculated to resist lateral strains as the more robust jaws of th majority of the existing *Felidæ*.

Nimravus confertus Cope.

Although a left mandibular ramus is all that I have been ab to obtain of this cat, the evidence is sufficient that it is speci

cally different from the others enumerated in this chapter. It is inferior in size, and peculiar in the reduced symphyseal and in-

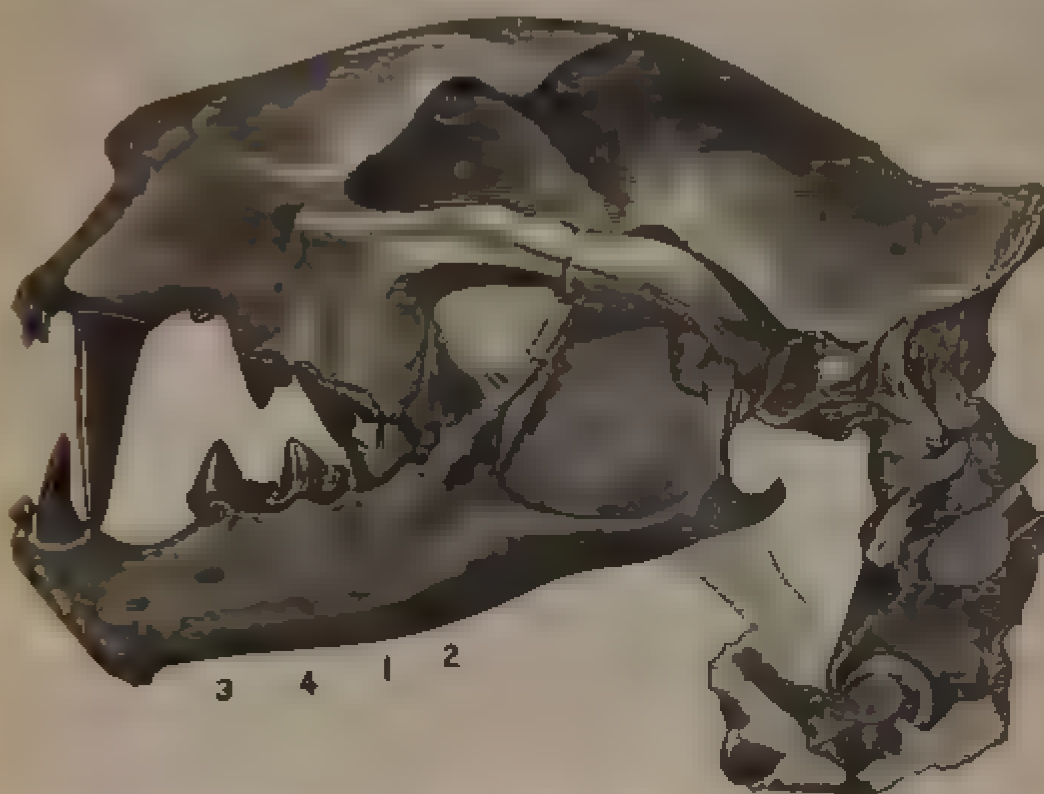


Fig. 7. *Nimravus gomphodus*, two-fifths natural size. Mus. Cope. From Vol. IV, U. S. Geol. Surv. Terrs.

cisive parts of the mandible. It was found by Mr. Wortman in the bad-lands of the John Day valley, Oregon.

Division III. The Primitive Sabre-tooths.

DINICTIS Leidy.

With this genus we enter the group of the primitive sabre-tooths, commencing with the most generalized form. The skeleton is yet unknown, but the skull and dentition are those of a true sabre-tooth, and there seems to be no ground for believing the Musteline affinities suggested by Leidy.[1] It occupies the lowest position on the line of the sabre-tooths, on account of its numerous and simply constructed molar teeth, and stands in immediate connection with the false sabre-tooth group, having exactly the dental formula of *Ælurogale* Filh. On this account I formerly united the two genera, but now believe that the absence of the inferior flange of the mandible in *Ælurogale* is sufficient ground for maintaining them as distinct. The latter genus, in this respect, exactly resembles *Archælurus* and *Nimravus*.

Remains of this genus are quite abundant in the White River

[1] Extinct Mammalia, Dak., Nebr., p. 64.

formation in Nebraska and Colorado. They principally belong to the longest known and typical species, *D. felina* Leidy. Specimens are much less numerous in the Truckee beds of Oregon. Two species have been obtained from the former horizon, the *D. felina* and *D squalidens*, and one from the latter, the *D. cyclops.*

Dinictis cyclops Cope

This cat is represented by a perfect cranium with its mandible, which lacks only the posterior portions. The dentition is com-

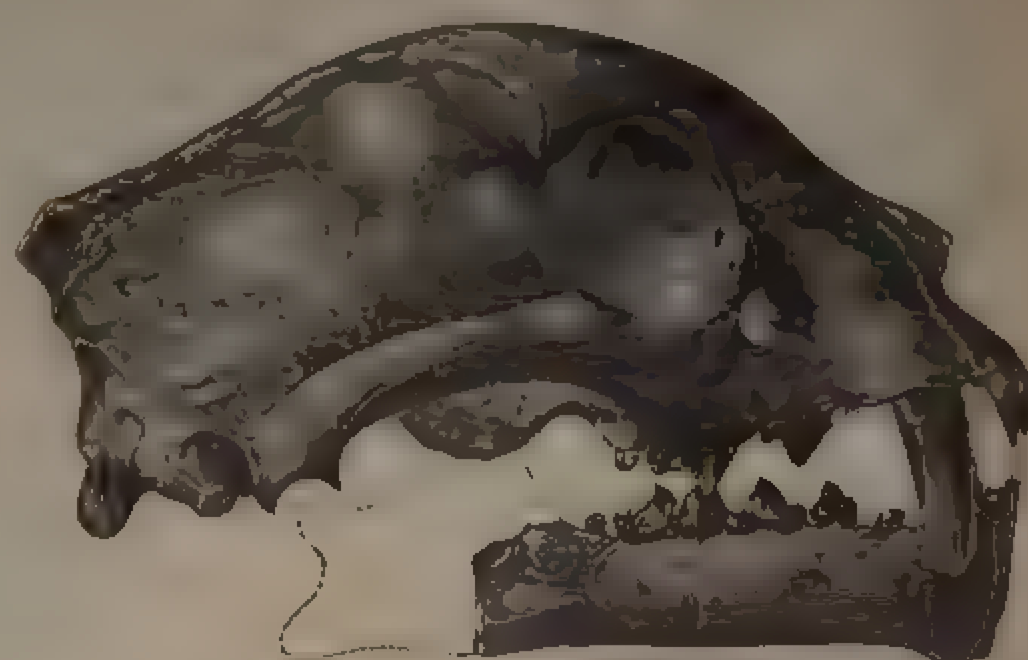


Fig. 8.—*Dinictis cyclops*, one half natural size Mus Cope. From Vol IV, U. S Geol Surv. Terrs

plete, excepting the posterior parts of the two inferior sectorials, and the apices of the canines and incisors. The condition of the specimen allows its characters to be seen with clearness. The species was as large as the fully grown Canada lynx. Although of an inferior position in the system of *Carnivora*, its powers of destruction must have excelled those of the catamount. While the skull is generally less robust, its sectorial teeth are not smaller nor less effective than those of that animal, and the canines far excel those of the living species, as instruments for cutting their prey.

Dinictis felina Leidy.

This species is known from a number of crania and jaws. The former differ in their proportions from those of the *D. cyclops* having a relatively longer cerebral and shorter facial part of the skull. The anterior premolar teeth, especially in the upper jaw, were stronger than those of *D. cyclops.*

Dinictis squalidens.

In this species the first lower molar tooth has but one root, while in the others there are two. The canine tooth of the typical specimen has also a very peculiar form. The crown is short and wide like that of a *Carcharodon* shark, or somewhat like that of the sabre-tooth *Drepanodon latidens* Owen. As the first true molar tooth of this specimen was not fully protruded, it is possible that this canine belongs to the deciduous series.

As the tubercular tooth of the specimen on which this species was established could not be found in the jaw, I proposed to regard the species as typical of a genus distinct from *Dinictis*, remarking at the time that should such a tooth be ultimately found, the genus would have to be abandoned. Evidence of the existence of this tooth was afterwards obtained. Still later, another sabre-tooth was found with precisely the formula supposed to characterize this discarded genus (*Daptophilus*). Under the circumstances I thought best to give the former a new name, *Pogonodon.*

POGONODON Cope.

This genus represents a station on the line connecting *Dinictis* with the higher sabre-tooths, being intermediate between the former genus and *Hoplophoneus.* It lacks the tubercular inferior molar of *Dinictis*, and possesses the second inferior premolar characteristic of that genus, which is wanting in *Hoplophoneus.* One species is certainly known, and a second is provisionally referred here. The two are the largest of the sabre-tooths of North America, the type *B. platycopis* equaling in dimensions the largest species of *Drepanodon*, being only exceeded among the true sabre-tooths by the species of *Smilodon.* Unfortunately only the skull of the typical species is known. Several bones of the *P. brachyops* have been discovered.

Pogonodon platycopis Cope.

As the greater part of the skeleton of the *Pogonodon platycopis* is unknown, little can be said as to its general proportions. The skull is one-sixth shorter than that of the usual size of the tiger (*Uncia tigris*), and is equal to the largest Brazilian variety of the jaguar, and is considerably larger than the Texan form of that species.

The development of the dentition is concentrated in the canine teeth, and the powers of destruction of the animal would seem to

be disproportioned to its ability to appropriate its prey as food. The molar teeth are rather small, as is the case with the earliest

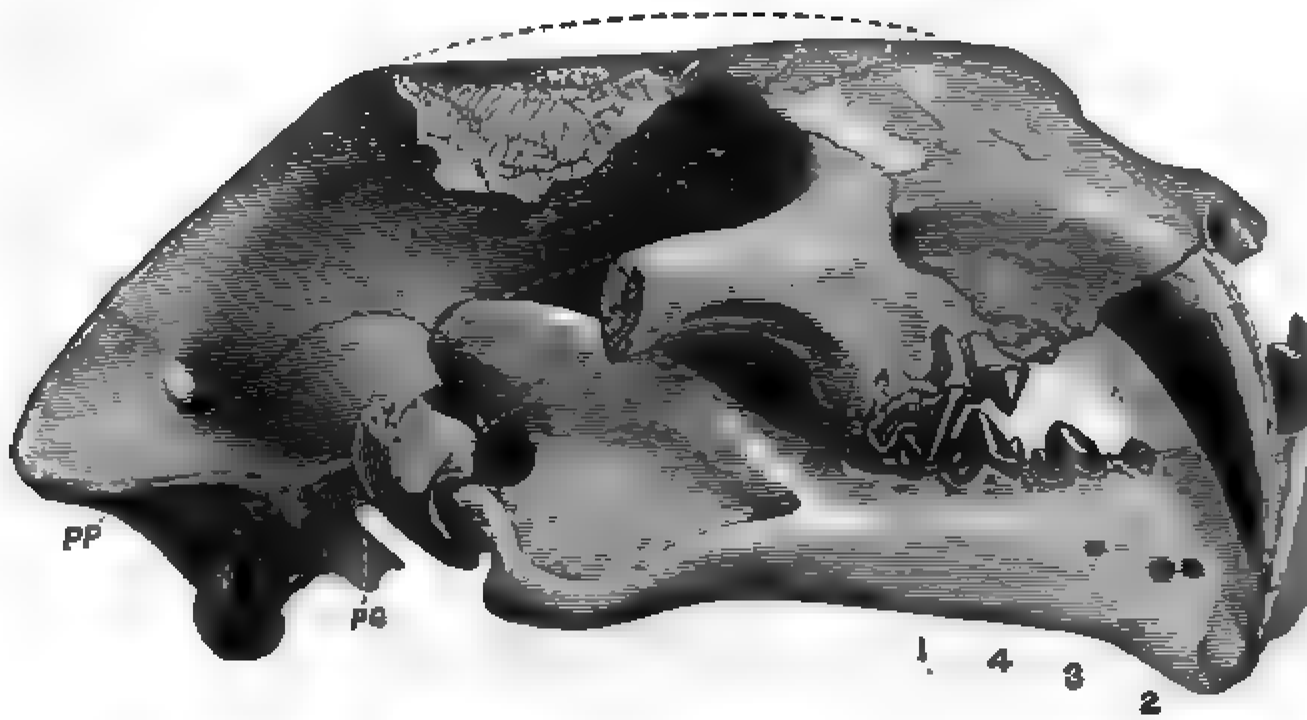


FIG. 9.—*Pogonodon platycopis*, less than two-fifths natural size. Mus. Cope. From Vol. IV, U. S. Geol. Surv. Terrs.

representatives of the canine family. The inferior sectorial is primitive and peculiar in its robust heel. We can suppose this species to have been a great destroyer of contemporary mammalian life, and that the largest ungulates of the Truckee fauna were its victims.

History. Science has hitherto had little knowledge of this species, and owes what is here recorded to a fortunate chance. The exploring party which I had sent into the John Day River valley under the direction of Mr. Jacob L. Wortman, in 1879, examined the bad-lands in the locality known as The Cove. In passing the bluffs on one occasion, a member of the party saw on the summit of a pinnacle of the crag what appeared to be a skull. The large shining objects supposed to be teeth attracted his attention, and he resolved to obtain the specimen. He, however, was unable to climb the cliff, and returning to camp narrated the circumstance. The other men of the party successively attempted to reach the object, but were compelled to descend without it, and in one case, at least, the return was made at considerable peril. A later attempt, made by Leander S. Davis, of the party, an experienced collector, was more successful. By cutting notches with a pick, in the face of the rock, he scaled the pinnacle and brought down the skull, but at considerable risk to limb and life.

Pogonodon brachyops Cope.

This was a most formidable animal, and its dental characters indicate a high degree of efficiency of both the lacerative and of the biting functions. While the *P. platycopis* has a larger development of the canine teeth, it is inferior in the relative size of

FIG. 11.

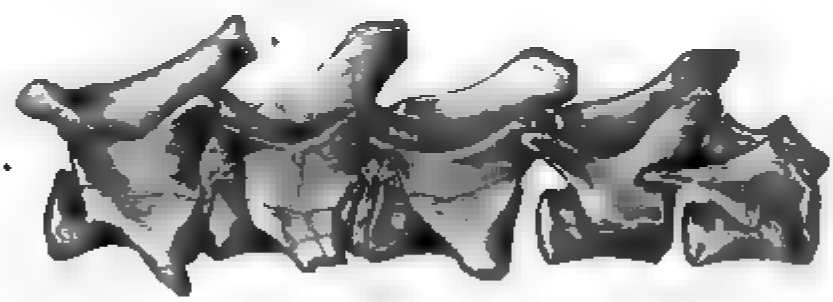


FIG. 10.

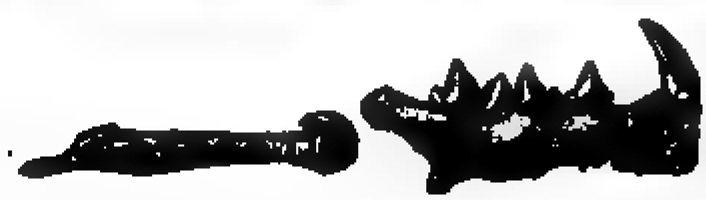


FIG. 10.—Lower jaw of *Nimravus confertus*, one-third natural size. FIG. 11.—Dorsal and lumbar vertebræ of *Pogonodon brachyops*, one third natural size. Mus. Cope. From Vol. IV, U. S. Geol. Surv. Terrs.

the sectorials. In the latter respect the *P. brachyops* resembles the species of *Nimravus* and *Archælurus*, but these are furnished with smaller or more slender canines. It, however, resembled the latter in having the feet relatively smaller than in the recent cats, a character which indicates inferior prehensile power. Unfortunately no ungual phalanges have been preserved, so that we cannot learn whether they confirmed this indication by resembling those of the *Cynælurus jubatus* or the still less specialized forms of other families.

History. This species was the first of the Oregon felines of which bones were obtained. It was first sent here by Mr. C. H. Sternberg from the Truckee Miocene bad-lands of the John Day valley, Oregon. Although I do not possess a mandible, I am satisfied that it is more nearly allied to *Dinictis* and the present genus than to *Nimravus*. It differs from the species of that genus and *Archælurus* in the following points: (1) the truncate triangular posttympanic process; (2) the transverse frontomaxillary suture; (3) the preorbital impressed depression; (4) the superior position of the postparietal foramen.

HOPLOPHONEUS Cope.

In this genus we reach the dental formula of *Drepanodon* and the true cats, while at the same time the primitive form of the

sectorials of the lower jaw remains. Three or four species only are known as yet, all from North America. We may expect, however, to find the genus in various parts of the world, wherever the beds occur which represent the time immediately preceding the epoch of the true sabre-tooths. The longest known species is the

Hoplophoneus primævus Leidy, from the White River bad-lands of Dakota and Nebraska. It is about as large as the Canada lynx, and has long and slender superior canines. A larger species, the *H. occidentalis* Leidy, from the same horizon and locality, is known from a single jaw fragment, as large as the corresponding part of the *Nimravus gomphodus.* Although the oldest members of the *Nimravidæ* yet known from North America, the *Drepanodon* characters of the mandible and of the superior canine tooth are well developed, much more so than in the false sabre-tooth group of the later Truckee epoch. In Europe, however, it must be remembered that the latter division commences still earlier, in the Upper Eocene, in the genus *Ælurogale* Filhol.

Hoplophoneus oreodontis Cope.

This species is nearly allied to the *Hoplophoneus primævus,* of which it may be only a regional variety. It is distinguished by its shorter and wider face and palate, a character especially seen in the shortness of the diastema, which is considerably less than in the Nebraska species. With this animal it compares much as the bull-dog does with the ordinary varieties of the genus *Canis.*

The two specimens I have described were found by myself on a denuded portion of the White River formation in Northeastern Colorado. At the same locality were multitudes of bones, mostly jaws, of fifty species of various orders of *Mammalia* and *Reptilia,* on many of which it doubtless preyed.

Hoplophoneus cerebralis Cope.

This peculiar species, the smallest of the genus, approaches nearest in dentition to the true sabre-tooths *(Drepanodon),* and is represented by a skull, from which the basioccipital region, a good deal of the right side, and the lower jaw are absent. It differs in many respects from all the members of this family of cats heretofore discovered in North America. In almost every point in the osteology of the skull it is peculiar. There is not as much space for the temporal muscle as in most of the extinct

species described, or as in the large recent *Unciæ*, but the points of origin of the muscle indicate that it was relatively stronger than in the domestic cat and the lynxes. Its single premolar is very small, so that the dentition for practical use is reduced, in the upper jaw, to the canine and sectorial. Both have been most effective instruments in the performance of their respective functions. The sectorial has a distinct anterior basal lobe. The space for the accommodation of the brain is relatively more ample than in any other feline of the formation, and, the inner wall indicates that the convolutions of the hemispheres were well developed. This species, if the cranium were of usual proportions, was about the size of the red lynx *(Lynx rufus)*.

The unique specimen of this species was found by Mr. J. L. Wortman in the bad-lands of Camp creek, one of the head tributaries of the Crooked river, in Central Oregon.

Hoplophoneus strigidens Cope.

Represented only by a part of a canine tooth. This tooth belonged to an animal of about the size of the *H. cerebralis*, and perhaps to that species. If so, it indicates for it a longer canine than usual, as its extremely compressed form points to a position at a considerable distance beyond the base of the crown. The probabilities are against reference to the *D. cerebralis*.

The tooth is the most elegant in form and perfect in its details yet found. As a cutting instrument it is superior to anything of human manufacture which I have seen.

Found by C. H. Sternberg on the John Day river, Oregon, in the Truckee beds.

FELIDÆ.

As defined in the preceding pages, the family of the true cats is of comparatively modern origin. We know that they existed during the Pliocene epoch, and it is very probable that they have been found in the Upper, and perhaps in Europe, in the Middle Miocene. If *Pseudælurus* and *Proælurus* pertain to it, the family dates from the Upper Eocene (Phosphorites).

Like the *Nimravidæ*, the *Felidæ* has its sabre-tooth division, with the long superior canine, reduced inferior canine, and flared lower jaw already described. In both divisions species are known which exceed in size any of those of the older family which have yet come to light. Such animals constitute the most formidable type of Carnivorous *Mammalia*.

The classification of the family is as follows :

I. The anterior and lateral faces of the mandible separated by an angle.

a. Inferior border of mandible flared downwards in front.

β. Inferior sectorial without heel ; an anterior lobe of the superior sectorial, and posterior lobes of the premolars.

Premolars $\frac{2}{2}$, first inferior two-rooted.......................*Drepanodon.*

Premolars $\frac{2}{2 \text{ or } 1}$; first inferior one-rooted.......................*Smilodon.*

II. The anterior and lateral faces of the mandible continuous, convex. (No inferior tubercular molar.)

a. Inferior sectorial without heel ; premolars with posterior lobes ; superior sectorial with anterior lobe.

β. Superior sectorial without internal heel ; ungual phalanges without inferior process.

Pupil round, premolars $\frac{2}{2}$; orbit open posteriorly..............*Cynælurus.*

ββ. Superior sectorial with internal heel ; ungual phalanges with inferior process.

γ. Pupil round.

Premolars $\frac{2}{2}$...*Uncia.*

Premolars $\frac{1}{2}$...*Neofelis.*

γγ. Pupil vertical.

Orbit closed behind ; premolars $\frac{2}{2}$..........................*Catolynx.*

Orbit open ; premolars $\frac{3}{2}$.......................................*Felis.*

Orbit open ; premolars $\frac{1}{2}$.......................................*Lynx.*

The tendency to reduction of the number of molar teeth is seen in the above genera, as already pointed out in the *Nimravidæ*. The only extinct genera are *Drepanodon* and *Smilodon*. Of the other genera the greater number of extinct species belong to *Uncia*.

The following catalogue of species and their distribution shows that but few of the extinct *Felidæ* have yet been found in North America. A star on a line between two columns shows an intermediate stratigraphical position. The extinct true cats whose crania have been discovered, belong to *Uncia*, but it is possible that some of the European species, which are as yet only known from lower jaws, may be species of the genus *Felis* or *Lynx*.

	Upper Eocene. Eur.	Lower Miocene Eur.	Lower Miocene Am.	Upper Miocene. Eur.	Upper Miocene. Am.	Pliocene. Asia. Eur.	Pliocene. Am.
Drepanodon palmidens Blv				×			
" ogygius Kp				×			
" aphanista Kp				×			
" sivalensis F. and C						×	
" palaeindicus Bose						×	
" megantereon C. and J						×	
" cultridens Cuv						×	
" maritimus Ger						×	
" latidens Ow						×	
Smilodon neogæus Lund							×
" necator Gerv							×
" fatalis Leidy							×
" gracilis Cope							×
Uncia media Lart				×			
" attica Gaudry					×		
" cristata F. and C						×	
" grandicristata Bose						×	
" christoli Gerv						×	
" pardinensis C. and J						×	
" arvernensis C. and J						×	
" brevirostris C. and J						×	
" issiodorensis C. and J						×	
" augusta Leidy							×
" atrox Leidy							×
" spelaea Gf						×	
" longifrons Burm							×

As already remarked, the genera of the Nimravine and Drepanodont lines are extinct, and this in spite of the fact that they presented the most perfect weapons of destruction in their canine teeth, from the earliest times. Their other modifications of structure advanced, *pari passu*, with those of the feline series, and, among others, the feet presented in the latter forms at least (*e. g.*, *Smilodon necator*, Gerv.), the most perfect prehensile power of the lions and tigers of to-day. As nothing but the characters of the canine teeth distinguished these from the typical felines, it is to these that we must look for the cause of their failure to continue. Prof. Flower's suggestion appears to be a good one, viz: that the length of these teeth became an inconvenience and a hindrance to their possessors. I think there can be no doubt that the huge canines in the *Smilodons* must have prevented the biting off of flesh from large pieces, so as to greatly interfere with feeding, and to keep the animals in poor condition. The size of the canines is such as to prevent their use as cutting instruments, excepting with the mouth closed, for the latter could not have been opened sufficiently to allow any object to enter it from the front.

Even when it opens so far as to allow the mandible to pass behind the apices of the canines, there would appear to be some risk of the latter's becoming caught on the point of one or the other canine, and forced to remain open, causing early starvation. Such may have been the fate of the fine individual of the *S. neogæus*, Lund, whose skull was found in Brazil by Lund, and which is familiar to us through the figures of De Blainville, etc.

DREPANODON Nesti. (*Machærodus* Kaup).

This genus as understood by most authors, belongs to the later Miocene and Pliocene, and has had numerous representatives in Europe and Asia. No species has as yet been found in America Some of the species described by authors are only known from fragments, so that much remains to be ascertained as to the prevalence among them of the characters I have assigned to the genus and family. Those given are derived from the two species best known, the *D. cultridens* and *D. megantereon*, which have been readily obtained from the descriptions and figures of authors.

It is difficult to ascertain the number of European species. Pomel's catalogue is generally cited, and this is, with some subtractions and additions, the basis of the list already given.

SMILODON Lund.

Besides the family characters already given, this genus differs from the *Nimravidæ* in two other important respects. In both points it differs also from such existing members of the *Felidæ* with which I have been able to compare it. In both *S. fatalis* and *S. necator*, the posttympanic process of the skull is coössified with the postglenoid, thus closing the auricular meatus below. It thus differs from other *Felidæ* as the genus *Rhinocerus* differs from various other members of *Rhinoceridæ*. The second point has been indicated by Prof. Gervais. There is no epitrochlear arterial canal, such as belongs to cats and *Nimravidæ* generally. This I have only verified on the *S. necator*.

This genus represents in America the Drepanodons of the Old World. The known species belong to the Pliocene period, and were the cotemporaries of the gigantic sloths and *Glyptodons*, which at that time ranged over the entire American continent. Their powerful limbs terminated by immense claws, bespeak for them exceptional force in striking and tearing their prey, and the long compressed canine teeth are well adapted for penetrating the

tough hides and muscles of the large Edentata, which were doubtless their food. There are known two species of large size from

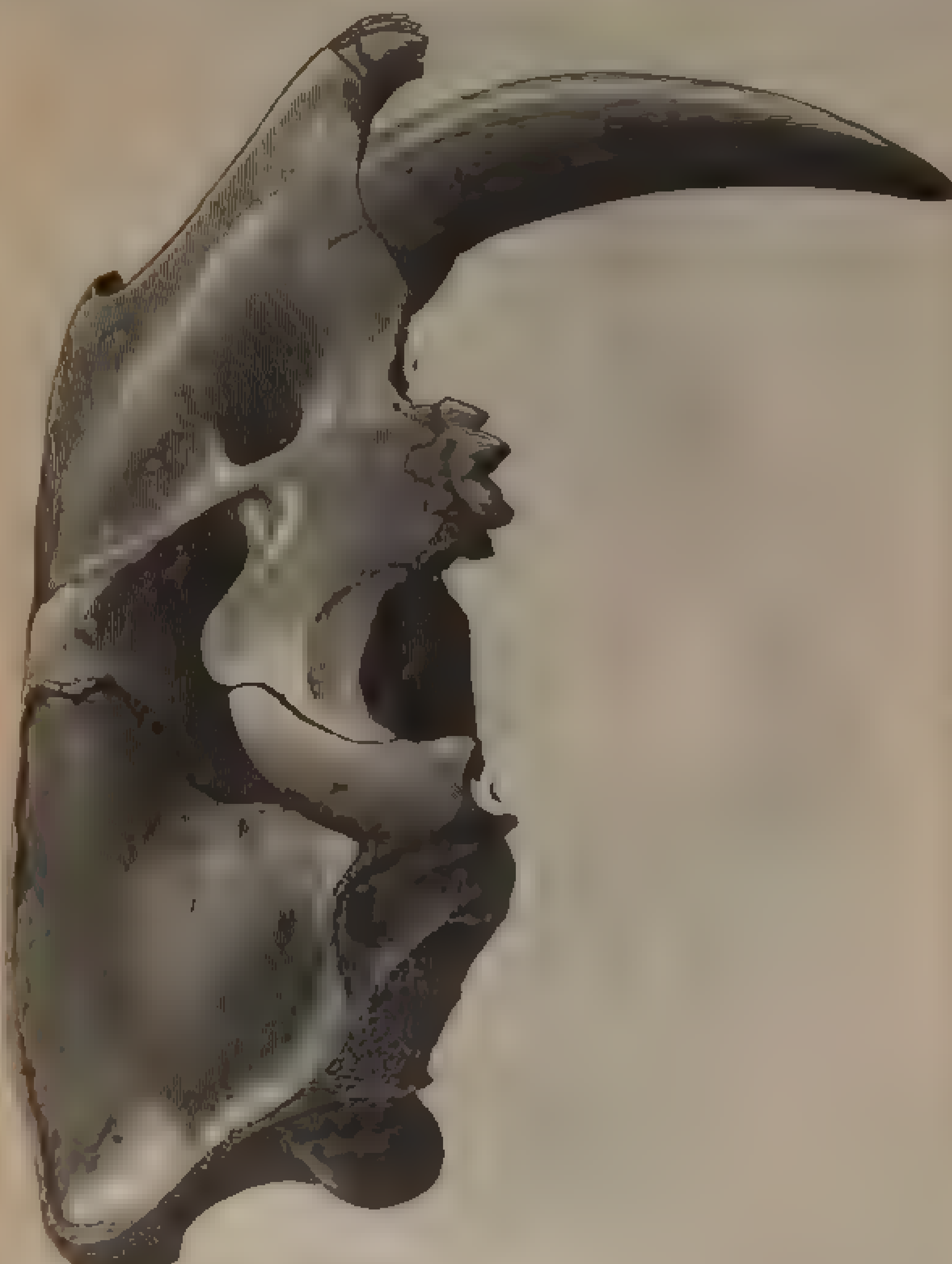
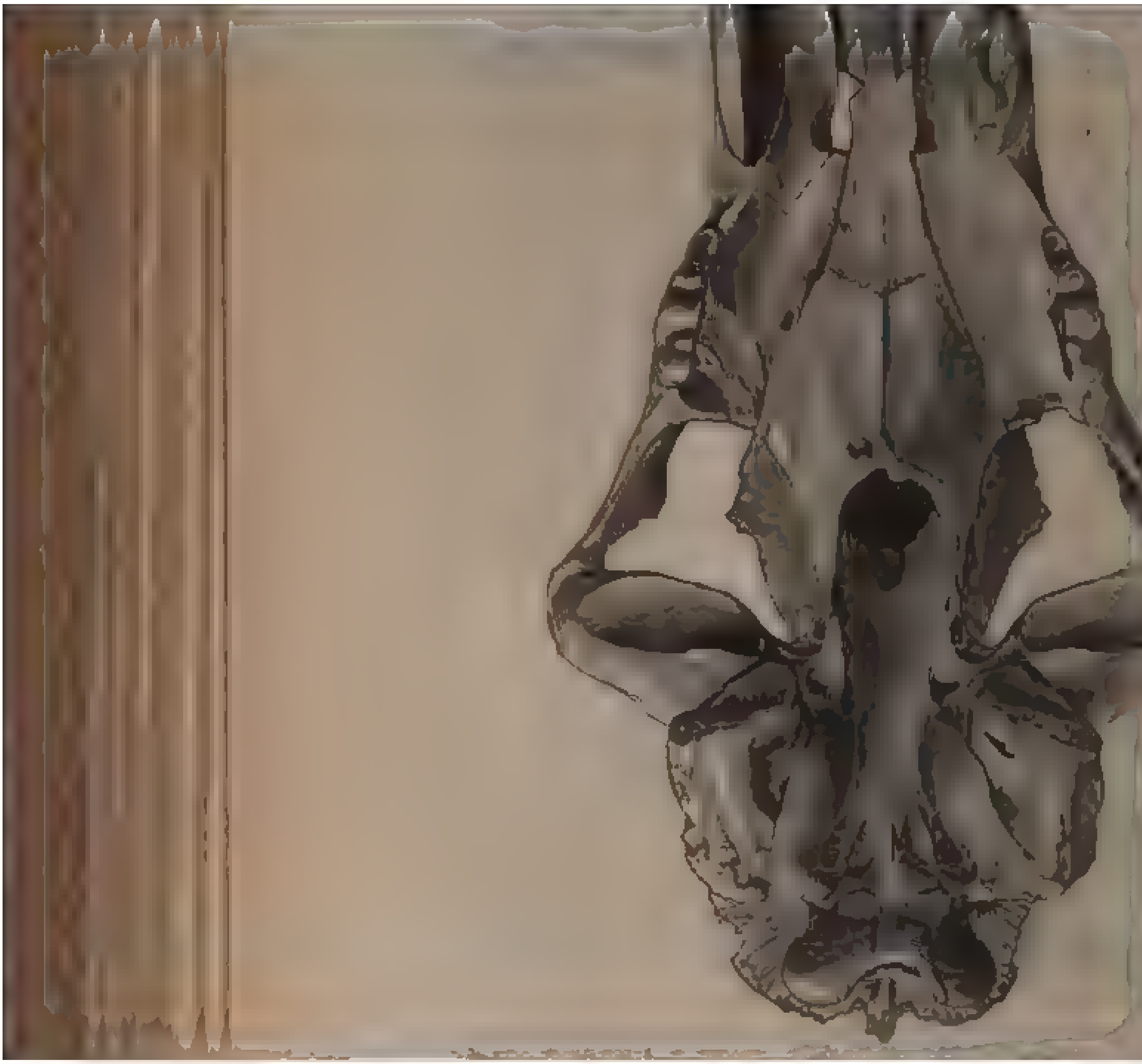


FIG. 13.—*Smilodon necator* Gervais, one-third natural size. Original. Mus. Cope.

the Pliocene of South America, and probably two species from North America. A figure of the skeleton of the *S. necator* Gervais accompanies this paper. It is a copy of a lithograph taken by Prof. Burmeister from a specimen in the Museum of Buenos Ayres. The second known skeleton, found by M. Larroque near to the village Areco, a few miles west of Buenos Ayres, is in possession of the writer. Lateral and inferior views



the name of *Trucifelis fatalis*. As it possesses a second anterior basal lobe of the superior sectorial, it is doubtless a *Smilodon*. I am confirmed in this opinion by the characters presented by an important specimen sent me by G. W. Marnock, who obtained it in Southwestern Texas. It consists of that portion of a cranium, which is posterior to the orbits, and represents an animal of the size of the *S. necator*, or of a large tiger. The positions of the foramina and the conjunction of the posttympanic and postglenoid processes are as in the *S. necator*. When more of this species is known, it will doubtless be found to be our largest sabre-tooth.

Among the remains obtained by Charles M. Wheatley from a cave on the Schuylkill river, in Pennsylvania, which I described in 1871, there occurred a part of the canine of a sabre-tooth. Hoping to obtain better specimens, I did not include it in the published lists. Having established the existence of the genus *Smilodon* as a contemporary of the sloths during the Pliocene period in North America, it becomes probable that the species of the caves is also to be referred to it. The canine in question has lost most of its crown. It is of smaller size than that of either of the three species previously mentioned, and its basal portion is more compressed. This compression is a marked character, and I refer to it the name *Smilodon gracilis*, by which the species may be known.

FIG. 15. — *Smilodon necator;* humerus of specimen Figs. 12, 13, from front, one-third natural size. Mus. Cope.

UNCIA Gray (Cope emend.).

Extinct species of this genus have been found in the late Miocene and subsequent deposits in India, Europe and North America. It is distinguished from the

true *Felis* by the round form of its pupils. This can only be observed in the living species, so that some correlated index of it must be used in determining the genus from skulls. This Dr Gray shows is seen in the small size of the orbits, which are always less than those of the species of *Felis*.

Fragmentary remains from the Loup Fork formation of Nebraska and the Pliocene and Quaternary of Mississippi and California have been described by Leidy under the names of *Felis augustus*, *F. atrox* and *F. imperialis*. Dr. Leidy suggests that there may have been two species, the one (*F. augustus*) characteristic of the Loup Fork epoch, and *F. atrox*, the second, belonging to a later period. The *Uncia augusta* was intermediate in size between the *U. onca* and the tiger, while the *Uncia atrox* was, according to Leidy, larger than the lion or tiger. It represents in America the *Uncia spelea* of the European caves, and should be carefully compared with that species.

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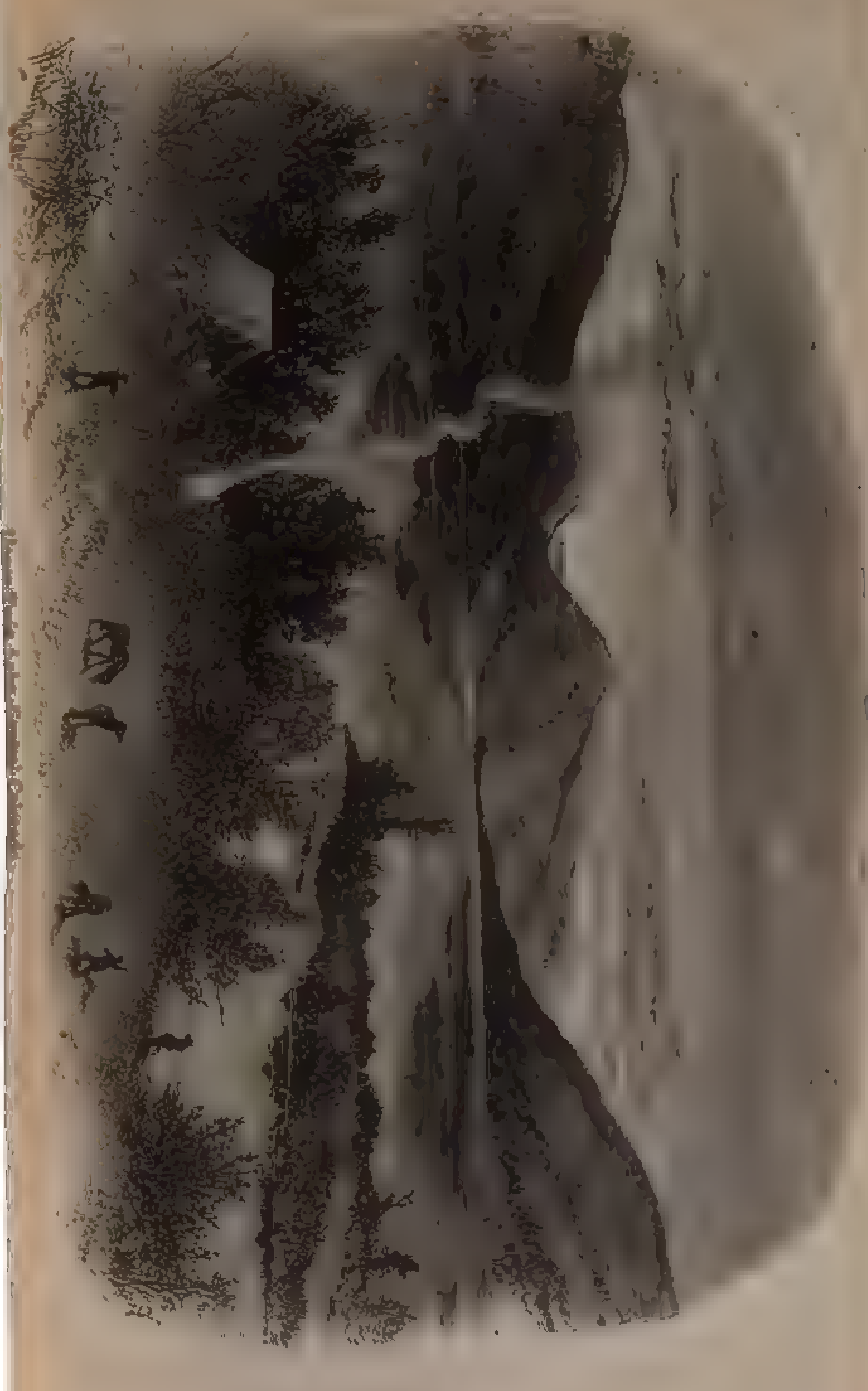
TWIN LAKES AND TEOCALLI MOUNTAIN, CENTRAL COLORADO, WITH REMARKS ON THE GLACIAL PHENOMENA OF THAT REGION.

BY F. V. HAYDEN.

ONE of the most interesting localities in Central Colorado is the Twin lakes. These lakes are situated at the point where Lake Fork issues from the Sierra Madre, or Wasatch range, into the short valley which opens into the Upper Arkansas. At no distant period this point, with its surroundings, will form one of the most popular and desirable watering places in the West; already every available spot in the vicinity has been purchased for the purpose of erecting summer houses. The elevation of the lakes is 9357 feet above sea level. Some of the loftiest peaks in Colorado are in full view of the surrounding hills. Massive mountain, Mt. Elbert, Harvard, Yale and Princeton peaks, rise to heights of over 14,000 feet. The massive granite mountains on every side, are among the most rugged and picturesque in the Rocky Mountain region.

During the survey of this region in 1873, under the direction of the writer, these lakes were carefully sounded, and their greatest depths were found to be respectively seventy and seventy-six feet. These are formed in basins, as it were, which



were undoubtedly scooped or worn out of the granite rocks by glacial action. They afford a splendid example of what Prof. Ramsay, the eminent geologist of England, calls "Rock Basins," the origin of which he has so graphically explained in his volume on the "Physical Geography and Geology of Great Britain." In the Upper Arkansas valley there seems to have existed in glacial times, one immense glacier, rising to the height of 1000 to 1500 feet on the mountain sides, and filling up the entire valley, with tongues or branches extending up the numerous side cañons. A description of this remarkable district may be condensed from the Report of the U. S. Geol. and Geog. Survey of the Territories for 1873 and 1874. The Arkansas valley, from its head in Tennessee pass to the point where the river cuts through the Front or Colorado range and opens out into the plains, has been worn out of the granite mass to a great extent. The origin of this valley is mostly due to erosion. From the crest of the Park range, on the east side of the Arkansas river, to that of the Wasatch on the west, the average distance in a straight line must be at least ten or fifteen miles, and the average elevation above the water level of the river 1500 feet. It is probable that this great space was, at no very ancient period, filled with one vast glacier, which doubtless performed the greater part of the grinding up of the rocks and the wearing out of the valley. The glacier-worn sides of the gorges, point strongly to that conclusion.

But in this brief article we must confine ourselves mostly to the limited district, the valley of Lake Fork, in which the Twin lakes are located, the subject of the illustration. The valley of Lake creek is filled with the morainal deposits for which both sides of the Wasatch range of mountains are so remarkable. It would seem that the great glacial force moved here in a direction a little south of east, inasmuch as the mass of the detrital matter is heaped up on the south side. The two lakes are about three hundred and fifty yards apart, with a small stream flowing from the upper into the lower, about twenty feet in width. The interval is made up of worn detrital matter, but over it and around both lakes, are mounds or oblong ridges of drift; and scattered over the surface, are masses of granite, coarse in texture, with crystals of feldspar, one and two inches in diameter, aggregated together. The rock has the appearance of a feldspathic breccia. The lower lake is about two and a-half miles in length

and one and a-half miles in width, the upper lake is one mile in length and a-half mile in width. As we have stated before, the greatest depth was found to be seventy to seventy-six feet. The Lake creek rises about twelve or fifteen miles away, at the crest of the Wasatch range, and flows through a deep gorge or cañon, with signs of glacial erosion its entire length, and as it issues from the mountains into the main valley, has become a considerable stream. These lakes are really expansions or basins in the stream and a part of it. That these lakes have been slowly diminishing in area, we know by the land bordering on both of them. Above the Upper Twin lake, there is a half mile in width of boggy meadow, which at no distant period must have been covered by the lake. At the head of the valley, or where the gorge begins, there is a sort of natural bridge, where the stream has worn a narrow channel through the rocks. At the summit the gorge is about eight feet wide, and in it a huge boulder has lodged. The stream rushes down its steep, narrow, winding channel with great force. On the north side there is a huge boulder just ready to topple off into the channel, which is fifty feet in diameter. On the sides of the channel are several most remarkable rounded cavities worn in, like pot holes, six to ten feet in diameter. One of these occurs twenty feet above the water level of the creek at the present time. The worn rocks, or *roches moutonnes*, are most admirably shown everywhere, and portions crop out in the bottom of the valley to indicate the force as well as the extent of the erosion. It is quite possible that if all the *débris* could be stripped off the gorge and valley, the grooved or scratched surfaces would be apparent. One immense mountain mass on the north side seems to have resisted the eroding forces so that from base to summit, a heighth of one thousand feet, it is smooth, like enamel. The great glacier which must have filled up the channel, has probably been obstructed, in its slow downward movement, by this projecting point of the mountain. The great branch glaciers of Lake creek must have been at least 1500 feet thick. The valley or gorge is of nearly uniform width, about one-fourth of a mile, and the glacier must have ploughed its way along, removing a great thickness of the gneissic rocks on either side and on the bottom, rounded remnants of which can be seen cropping everywhere from the detritus. About six miles above Twin lakes, in a straight line, Lake creek forks, one branch extending up toward the north-west, and the other south-west.

Both separate again soon into a number of smaller branches, which end in amphitheaters near the crest. There is not space here to dwell in detail on the remarkable features of this region. The student will find here the most wonderful examples of erosion, and an almost unlimited view of varied glacial phenomena; the lover of sport can find abundant trout fishing in the lakes and various kinds of game in the mountains; the invalid, pure air and water, so that at no distant period the region about Twin lakes must become a famous resort for seekers after health and pleasure.

Teocalli mountain.—On the west side of the Main or Wasatch range, in a nearly direct line from the Twin lakes, is a mountain peak of very singular but interesting appearance. This peak forms the subject of our second illustration. The name was given this peak by the Survey on account of its resemblance to the celebrated sacrificial mound of Mexico. The mass of rock seems to have been elevated by forces acting in a vertical manner so that the strata are nearly or quite horizontal, yet its summit is 13,131 feet above sea level. The peculiar form is pyramidal and the strata of various colored sandstone and clays are so arranged as to form a series of steps from base to summit. The texture of the rocks is quite varied, from a fine sandstone or quartzite to a conglomerate interlaid with thin seams of clay, which is weathered out so as to permit the harder beds to project out like steps. There is an enormous thickness of these variegated beds, and while a great portion may be of the age of the Jura-trias, the lower portion is believed to belong to the era of the Permian, or Permo-carboniferous. From this point can be seen distinctly the remarkably picturesque forms of Pyramid, Maroon and other mountains, rising to an elevation of over 14,000 feet, yet composed of nearly horizontal beds of these variegated rocks. The prevailing color is a dull [illegible] purple. Maroon peak, 14,003 feet above sea level, recei[illegible]me from its prevailing color. Great numbers of these [illegible] in the aggregate, form the celebrated Elk Mounta[illegible] Central Colorado, seem to have been originally thr[illegible]gh the overlying Cretaceous and Tertiary beds with [illegible]egularity, producing a series [illegible] faults and overturning[illegible]ualled in very few localities [illegible] continent. Teo[illegible] does not present the [illegible] of having bee[illegible] the uplift, and the vast

thickness of superincumbent strata may have been removed prior to its elevation, but we know that at least 10,000 feet of more modern beds, at one period rested upon it. The illustrations accompanying this paper will serve to convey some idea to the reader of the unique scenery which abounds in the mountain regions of Central Colorado.

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A SKETCH OF THE PROGRESS OF BOTANY IN THE UNITED STATES IN THE YEAR 1879.

BY PROF. C. E. BESSEY.

A. Anatomy and Physiology.—In this department the observations of the botanists of this country, as shown by their published papers, were directed mainly to the reproductive organs and their functions; and with one or two exceptions the papers were short, involving but a few quickly-made observations. Little or no work* was done in micro-anatomy (histology) and proper physiology.

While we may regret that so much of the field has been so sadly neglected in our country, we should remember, that as a rule our botanists are overloaded with other duties which render it often impossible for them to command the time for making the necessary investigations.

In the January number of the NATURALIST, Prof. J. E. Todd published a paper "On Certain Contrivances for Cross-fertilization in Flowers," illustrated by eight wood-cuts, in which he described the modes of pollination in Martynia, Penstemon and Lobelia, and added a few observations upon the structure of the Iris flower. In the same journal Mr. William Trelease published (p. 427) a paper "On the Fertilization of several species of Lobelia," and another (p. 688) on "The Fertilization of our native species of Clitoria and Centrosema," both illustrated by several cuts. Thomas Meehan's paper "On the Fertilization of Yucca," read before the American Association for the Advancement of Science, is interesting from the fact that it shows that in Yucca, where we appear to have so perfect an adaptation of flower and insect *(Pronuba yuccasella)*, pollination may still be effected by other and unusual means.

Prof. W. J. Beal described in the *American Journal of Science and Arts* for May, some "Experiments in Cross-breeding plants

of the same Variety." Of Indian corn and wax beans, two lots of each were obtained from widely different localities; these were so planted as to secure cross-fertilization in certain cases, and fertilization without crossing in others. The result was shown to be highly favorable to the crossed plants.

Dr. M. E. Elrod's paper on the "Seeds of the Violet and other plants as Projectiles," in the February NATURALIST, and that of R. E. C. Stearns in the July number of the same journal, on "The Form of Seeds as a Factor in Natural Selection," contribute somewhat to our knowledge of the means for the distribution of the seeds of plants.

Of other papers in this department, the following may be mentioned: "Trimorphism in *Lithospermum canescens*," by Mr. E. F. Smith in the *Botanical Gazette* for June; "Sexual differentiation in *Epigæa repens*," by Mr. L. F. Ward; "Note on the movement of the stamens of *Sabbatia angularis*," by the same author, both read before the American Association for the Advancement of Science; "Objects of Sex and Odor in Flowers," by Thomas Meehan, read before the A. A. A. S., and printed in the *Scientific American*, Oct. 1879, pointing out that "variation is not merely an incident of form, but that it must necessarily be a primary object in nature; that the institution of sex is but an incident in the primary law of variation; and that all the machinery for fertilization and cross-fertilization is with the object of causing a change of form far in the future, and with no material bearing on the good of the individual, or even of the race." Here should be mentioned Prof. Tuckerman's paper, "The Question of the Gonidia of Lichens" (*Am. Jour. Sci. and Arts*, March, 1879), a review of Dr. Mink's recently published observations. The reviewer gives a short résumé of the lichen-gonidia controversy, and records some observations of his own, which he regarded as confirmatory of those of Dr. Minks.

B. Systematic Botany.—a. Fungi.—One of the most important contributions in this department is Mr. C. H. Peck's "Report of the Botanist" in the Thirty-first Annual Report of the New York State Museum of Natural History. This report, although bearing date of January, 1878, was actually not published until 1879. Many new species of Fungi (mostly Basidiomycetes and Ascomycetes) are described. One of the most interesting of these is the one which lives parasitically within the abdomen of the seventeen-

year Cicada, and which Mr. Peck proposes to put into the new genus *Massospora*, which he briefly characterizes. The table giving the synonymy of the Myxomycetes of New York, and the critical notes which follow are valuable, especially to those who do not have access to Rostafinski's work.

In the "United States Species of Lycoperdon," a paper read Feb. 4, 1879, by Mr. C. H. Peck, before the Albany Institute, we have the first approximately complete account of the puff-balls of this country. The paper opens with a general description of puff-balls, covering six pages. This is followed by a synoptical table of the species, which are arranged under two sections, viz: *Bovistoides* and *Proteoides*, according as the peridium ruptures irregularly or regularly. The excellent specific descriptions which follow in the body of the paper, are based upon Mr. Peck's personal observations, and these are supplemented by remarks upon the general and more obvious characters, as well as the distinguishing features of such species as are closely allied and liable to be confused. Nineteen species are thus described in full, and four others, known to occur in the United States, but not seen by Mr. Peck, are more briefly noticed at the end of the paper. A list of publications consulted closes this valuable contribution.

The same indefatigable mycologist, in several short articles in the *Botanical Gazette*, described thirty-eight new species from various parts of the United States. Of these twenty are Uredineæ, six Hymenomycetes and four Gasteromycetes.

M. C. Cooke, in the March number of *Grevillea* described several new species from California, and in the September number of the same journal, Mr. Cooke and J. B. Ellis described thirty or more new Fungi from New Jersey.

Baron Theumen's short contribution in the October Bulletin of the Torrey Botanical Club, contained descriptions of several new species.

In F. B. Hine's "Observations on Several Forms of Saprolegnieæ," begun in the October (1878) *American Quarterly Microscopical Journal*, and concluded in January, 1879, we have one of the first records of a careful study of the plants of this interesting order in this country. Four plates, filled with many figures, accompany the paper.

J. B. Ellis' paper "On the Variability of *Sphæria quercuum*

Schw.," published in the Proceedings of the Academy of Natural Sciences of Philadelphia, 1879, p. 66, shows the growth of a healthy critical spirit, the author having satisfied himself that the species named includes thirteen or more forms hitherto regarded as distinct species.

Dr. Farlow's lecture on "The Diseases of Forest Trees," an abstract of which was published in the Transactions of the Massachusetts Horticultural Society (1879), consists of a plain account of the fungoid growths upon forest trees. As a contribution to the popular economic mycology of the United States, this lecture is to be regarded as a most valuable one.

Thomas G. Lea's list of "The Fungi collected in the vicinity of Cincinnati," originally published in 1849, was republished with a few additions, by J. F. James in the Journal of the Cincinnati Society of Natural History, 1879. In its revised form it includes 319 species.

Of the two American *exsiccati* now publishing, Centuries III and IV of Ravenel and Cooke's Fungi Americani appeared early in 1879, and Centuries II and III of Ellis' North American Fungi.

b. Algæ.—In the Proceedings of the Boston Society of Natural History, 1879, Dr. B. D. Halsted published a valuable paper on the "Classification and Description of the American species of Characeæ." Eight species of Nitella, one of Tolypella and nine of Chara are fully described. The references to descriptions and *exsiccati* appear to be full, and the geographical distribution of the species is as well worked out as the material at the command of the author would admit. A valuable list of the works consulted in its preparation is found at the end of the paper.

Dr. T. F. Allen's "Characeæ Americanæ," of which Parts I and II were issued in 1879, is another valuable contribution to our knowledge of the hitherto little studied American species of the Characeæ. Each part consists of a colored lithograph of a species accompanied by descriptive letterpress.

"The Seaweeds of Salt lake," is the title of a short article by Dr. Packard in the November NATURALIST. It is composed mainly of Dr. Farlow's preliminary report upon a collection of Algæ obtained by Dr. Packard from the Great Salt lake of Utah. Two of the species are recognized as marine forms, while the third is new.

Francis Wolle, in an article entitled "Dubious character of

some of the genera of fresh water Algæ," published in the *American Quarterly Microscopical Journal*, records some of his observations upon the unicellular forms of vegetation occurring in fresh water, and "questions the place given them as plants," and suggests that many of them "are merely forms of gonidia or spores or sporangia, various stages of development in the life history of filamentous plants." The same writer, in the Bulletin of the Torrey Botanical Club (January and February, 1879), published a "Synopsis of the Discoveries and Researches of fresh water Algæ in 1878," in which some American species are, for the first time, described, and many others catalogued.

Fasciculus III of Algæ Exsiccatæ Am. Bor., containing thirty species of the larger algæ (Fucaceæ and Florideæ) was issued by the authors, Farlow, Anderson and Eaton, during the year 1879.

c. Lichens.—But little appears to have been published in 1879 by the lichenologists of this country. Prof. Tuckerman's list of the lichens in Dr. Rothrock's "Catalogue of the plants collected in Nevada, Utah, California, Colorado, New Mexico and Arizona" (Wheeler's Report, Vol. VI) is the only publication in this department which has come to hand.

d. Bryophytes (Mosses and Liverworts).—In the catalogue just referred to above, Thomas P. James enumerates seventy-nine species of mosses, and C. F. Austin fifteen species of liverworts. In Mr. James' list the less known species and genera are described, and to nearly all short notes upon habit or habitat are appended.

"Descriptions of some new species of North American Mosses," by Leo Lesquereux and Thomas P. James (Proc. Amer. Academy of Arts and Sciences, 1879), includes the descriptions of fourteen new species, mostly from the Southern and Western States.

Under the titles of "Some New Musci" (*Botanical Gazette*, April, 1879), "Bryological Notes" (Bull. Torr. Bot. Club, Sept., 1879), and "Notes on Hepaticology" (Ibid, April, 1879), the lamented C. F. Austin described a considerable number of new mosses and liverworts.

e. Pteridophytes (Vascular Cryptogams). — It is a pleasure to direct the attention of botanists to the industry of Prof. Eaton, whose "Ferns of the Southwest" (Wheeler's Report, Vol. VI), "The Ferns of North America" and "New and little known Ferns of the United States" (Bull. Torr. Bot. Club, pp. 306, 360), appeared wholly or in part in 1879. The first includes descrip-

tions of all the less known ferns of the Southwest, *i. e.*, the Utah-Arizona region. In all sixty-six species are noticed, and one figured in Plate xxx. It should be remembered that while the preface to the work bears the date of 1877, the date of its actual appearance in the volume of which it forms a part is properly 1879. A few copies were separately distributed some time in advance of the publication of the whole report, but the exact date of this distribution is not known to the writer of this paper. The great work on the "Ferns of North America" with its fine colored plates was nearly brought to a close during the year 1879. It will forever remain a monument to the ability of its author.

In "Fern Etchings," by John Williamson we have a notable example of the good work which may be done by the painstaking lover of plants. The volume contains plates of sixty-eight ferns of the United States, with letterpress descriptions of each.

G. E. Davenport's "Catalogue of the 'Davenport Herbarium' of North American Ferns" is interesting as being the first complete catalogue of the ferns of this country. It contains one hundred and forty-two species, besides sixteen varieties.

Among other publications, Mr. J. F. James' list of vascular cryptogams in his catalogue of Cincinnati plants, above referred to, and Prof. J. W. Chickering's list in his catalogue of the plants of Dakota and Montana (Bull. U. S. Geol. and Gograph. Survey, Vol. IV), deserve mention. Baron Eggers' similar list, in his "Flora of St. Croix and the Virgin islands" (Bull. U. S. Nat. Museum) should also probably be noticed here.

f. Phanerogams.—The most notable contribution in this department is the "Report upon the Botanical Collections made in portions of Nevada, Utah, California, Colorado, New Mexico and Arizona, during the years 1871 to 1875," by Dr. J. T. Rothrock, being Vol. VI of the Reports upon the U. S. Geographical Surveys west of the 100th meridian, in charge of Lieut. Wheeler. The work contains a General Report, in which the general features of the flora of the Colorado and the New Mexico districts are separately described. This portion also contains some valuable and interesting notes upon economic botany. The main part of the work consists of the catalogue proper. This is modeled after Sereno Watson's "Botany" of the Clarence King Reports. All the genera and species not contained in Gray's Manual, or in Watson's Botany, are here fully described.

While Dr. Rothrock bore the burden of the work, he availed himself freely of the aid of such excellent botanists as Mr. Watson, who worked out the Leguminosæ, Dr. Engelmann (Cactaceæ, Asclepiadaceæ, Gentianaceæ, Cuscuteæ, Euphorbiaceæ, Cupuliferæ, Loranthaceæ, Coniferæ, Amaryllidaceæ and Juncaceæ), Prof. Porter (Polemoniaceæ, Borraginaceæ, Scrophulariaceæ, Labiatæ and Polygonaceæ), M. S. Bebb (the genus Salix), Wm. Boot (the genus Carex) and Dr. Vasey (the Gramineæ). Twenty-nine excellent plates of flowering plants, mostly from drawings by Isaac Sprague, accompany the volume.

Dr. Gray's "Botanical Contributions" (Proc. Am. Acad. of Arts and Sciences) contained (1) "Characters of some new species of Compositæ in the Mexican collection made by C. C. Parry and Edward Palmer, chiefly in the Province of San Luis Potosi, in 1878," and (2) "Some new North American Genera, Species, &c." The new genera are *Suksdorfia*, a Saxifragaceous genus from the Columbia river, and *Howellia* (Lobeliaceæ) from Oregon.

Sereno Watson's "Contributions to American Botany, IX" (Proc. Am. Acad. of Arts and Sciences), issued July, 1879, contained (1) a "Revision of the North American Liliaceæ," and (2) "Descriptions of some new species of North American Plants." Under the first part, the fifty genera and two hundred and thirty-five native species are arranged and described. The whole order, which here includes the Melanthaceæ, is divided into sixteen tribes, "based upon the characters of the inflorescence, and such others as can be used without separating evidently allied genera." The Allieæ come first, then the Milleæ, Convallarieæ sixth, Yucceæ ninth, with Lilieæ, Uvularieæ, Trillieæ, Veratreæ following in order, and the Xerophylleæ at the end. In the second part the new genus *Hollisteria* (Eriogoneæ) is described.

"The Willows of California," by M. S. Bebb, issued July, 1879, consists of advance sheets of the "Botany of California, Vol. II." Six new species and seven new varieties are described.

Wm. M. Canby, in the *Botanical Gazette* for March, published under the title of "Notes on Baptisia," a valuable synopsis of an arrangement of the North American species, sixteen in number.

Among the lists of plants the following may be mentioned, viz: Prof. J. W. Chickering's "Catalogue of the Phænogamous and vascular Cryptogamous Plants collected during the summer of 1873 and 1874 in Dakota and Montana," published in Bull. U. S. Geol. and Geog Survey, Vol. IV; this enumerates 673 flowering

plants; J. F. James' "Catalogue of the Flowering Plants, Ferns and Fungi growing in the vicinity of Cincinnati," with 869 flowering plants; "Colorado Plants," a list of plants collected in Central and Southern Colorado, by I. C. Martindale, published in the November NATURALIST, with notes upon the rarer species; "Ballast Plants in New York city and its vicinity," by Addison Brown, in the November Bull. Torr. Bot. Club, enumerating 258 species.

Here must be mentioned the fine work by Thomas Meehan, "The Native Flowers and Ferns of the United States," consisting of chromo-lithographs with explanatory letter-press. This work continued to be issued in parts through the year.

Baron H. F. A. Eggers' "Flora of the St. Croix and Virgin Islands," published in Bull. U. S. Nat. Museum, should probably be noticed here. It enumerates 977 flowering plants.

C. Geographical and Geological.—Under the title of "A Visit to the Shell islands of Florida," A. H. Curtiss, in the February, March and May numbers of the *Botanical Gazette*, gives an interesting account of the vegetation of these little-visited islands. Much like this also is J. H. Redfield's "Notes of a Botanical Excursion into North Carolina," in the July and August numbers of the Bull. Torr. Bot. Club. In the party were Dr. Gray, Prof. Sargent, Mr. Canby and others, and one important object of the excursion was the finding of more specimens of Shortia.

"The Forests of Central Nevada, with some remarks on those of the Adjacent Regions," by Prof. C. S. Sargent, in the June *Am. Jour. Sci. and Arts*, contains notes upon the trees of the region, and comparative lists of the ligneous floras of the Rocky mountains, the Nevada and the Sierra Nevada regions. Much like the foregoing in treatment, but referring to very different plants, is Dr. Gray's paper, "The Pertinacity and Predominance of Weeds," in the September *Am. Jour. Sci. and Arts.*

In the Bulletin of the U. S. Geol. and Geographical Survey, Vol. v, W. H. Holmes contributes an interesting article on the "Fossil Forests of the Volcanic Tertiary Formations of the Yellowstone National Park." In some places the aggregate thickness of the strata reaches more than one vertical mile (5500 feet), and throughout these strata are found vast numbers of silicified remains of tree trunks. The article is accompanied by a figure of the north face of Amethyst mountain, showing a precipice composed of upwards of two thousand feet of strata.

In the *American Journal of Science and Arts* for April, Leo Lesquereux published a review under the title, "Notice of Gaston de Saporta's Work: 'The Plants of the world before the advent of man,'" which is to be regarded as a real contribution to Phytopalæontology.

Dr. Dawson's paper "On Tertiary Plants," published in the Report of the Geological Survey of Canada for 1879 has not been seen by the writer of this article.

D. Historical.—"The Chronological History of Plants: Man's record of his own existence illustrated through their names, uses and companionship," by Charles Pickering. In this large volume the author aimed to present in a condensed form all that is known as to the plants used by or spoken of by the ancients. It is a monument to the patience and industry of its lamented author.

Of a very different nature is Frederick Brendel's "Historical Sketch of the Science of Botany in North America from 1635 to 1840." (AM. NATURALIST, p. 754). Beginning with Cornut's *Canadensium Plantarum Historia*, 1635, "the first book on North American plants ever written," the author notices in chronological order the publications relating to American botany down to the year 1840.

E. Text Books.—Two notable text books made their appearance during the year, viz: Gray's "Botanical Text Book: I.—Structural Botany," and Goodale's "Concerning a few Common Plants." The first is the now well-known revision of the old Botanical Text Book. It is unnecessary to describe it; it at once took rank as one of the best books on structural botany extant. The second book is unfortunately less widely known. It was prepared as a supplement to a series of lectures to the teachers in the public schools of Boston and vicinity. As an aid to the earnest teacher seeking for the best methods of presenting the more important facts in the structure and physiology of the flowering plants, this little book is a valuable contribution.

F. Periodical Publications.—The two purely botanical journals of this country, *The Bulletin of the Torrey Botanical Club* and *The Botanical Gazette*, continued throughout the year without any marked change in their character.

The same may be said of the botanical departments of the AMERICAN NATURALIST and the *American Journal of Science and Arts.*

Two journals, in which botanical articles frequently appeared, ceased publication for want of adequate support, viz: *Science News* and *The American Quarterly Microscopical Journal.*

A SKETCH OF COMPARATIVE EMBRYOLOGY.

BY CHARLES SEDGWICK MINOT.

V.—THE GENERAL PRINCIPLES OF DEVELOPMENT.

THE sponges present, as we have seen, many exceptional peculiarities in their development. All the remaining Metazoa, on the other hand, may be treated as members of one series, which are governed by several general laws of embryonic growth, only a portion of which can, at present, be said to apply to the sponges.

The fundamental law of embryology is, that the simple precedes the complex, the general and typical, the special. All embryos obey this principle in their early growth, and most of them throughout all their growth; but some, after advancing to a certain stage, stop, or suffer a degeneration as it is technically called—in other words, only a part of their organs continue to develop; or even the whole animal retrogrades, *i. e.*, becomes simpler. Of degeneration,[1] the Crustacea offer many instances—one of the most familiar is the common barnacle, which in its young or larval state swims about the ocean freely, having well developed limbs and sense organs, but later loses some of its structures, becoming in its adult condition permanently attached to the rock. Almost all parasitic forms are degraded. In spite of these instances, progress is primary and universal, degeneration secondary and exceptional. In all cases the embryos present to us animals stripped of the secondary modifications found in adult life, and exhibiting the more essential peculiarities. Thus in very young birds we plainly recognize the gill slits and arches corresponding to the gills of fishes, but in the adult bird the gill slits have disappeared, and the arches so metamorphosed, that without knowing the embryo it would hardly be possible to discover their real connections, and their identity with the corresponding structures of fish. Embryology has proved that gills are typical of vertebrates, although many vertebrates have none in the adult state. Such insight the student of embryology may gather from any animal and every organ.

The next law is, that development is always gradual—to it there are no exceptions. Even the sudden metamorphoses, *e. g.*,

[1] E. Ray Lankester has recently published a very interesting little volume on degeneration in the Nature Series.

of caterpillars, are only apparent not real exceptions, for in the caterpillar the chrysalis is gradually formed, and when perfected is merely uncovered by the casting off of the caterpillar skin, which masked the changes going on within, and so also the opaque crust of the chrysalis conceals the butterfly being formed underneath. In some animals, however, the *visible* changes though still gradual are more rapid at one time than another, as when the larval starfish (Brachiolaria) passes in a few hours into the adult form. The explanation of the gradualness of development in the Metazoa, is the dependence of the process on alterations in the single cells, and as these are small and change slowly, the whole effect is produced imperceptibly; we notice only that the embryo has advanced since we examined it before, we cannot see it advancing.

Now, the construction of an animal out of the cells derived from the impregnated egg, depends on two things; *first*, the arrangement of the cells in relation to each other; *second*, alterations in the characters of the cells themselves. We have already seen that in the course of segmentation the cells become arranged in two layers, the *ectoderm* and *entoderm*, both consisting of a single stratum of cells, and later there is a set of cells, the *mesoderm*, in between, Fig. 20. Compare also Fig. 15, p. 248.

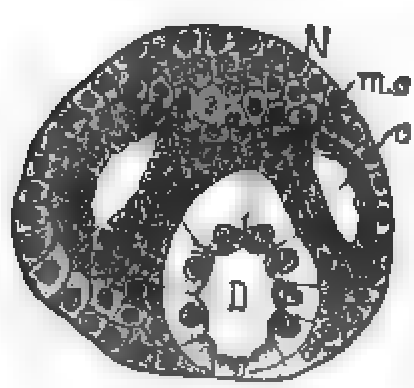

FIG. 20.—Transverse section through the head of embryo *Lumbricus trapezoides*. After Kleinenberg.

Before proceeding further it is desirable to say a few words about the middle germinal layer. Concerning its origin we have but little satisfactory information. In the lower animals (Radiates) it arises from cells which break away from the two primitive layers. In the jelly fishes it hardly exists as a distinct part, but as the Brothers Hertwig have shown, is rather an incompletely separated portion of the ectoderm. In the Bilateralia, or all animals except sponges and radiates, the mesoderm is always present as a distinct layer, which is formed *after* both the ectoderm and entoderm. Its exact origin has never been definitely settled, although the question has been interminably discussed, especially as regards vertebrates. It is, however, known that in some forms there are two special cells, one at each side of the primitive mouth of the gastrula, distinguished by their large size and containing a

large amount of nutritive matter. These cells are called the *mesoblasts*, and break up into smaller cells which form the middle germinal layer, Fig. 21. The cut represents a longitudinal section through the *double* embryo of *Lumbricus trapezoides*, after Kleinenberg. In this species the development is unique, for each egg normally grows into two individuals. The separation begins during segmentation. The two embryos are united by a cord of large cells, Fig. 21 *u*, and have at first a common mouth. In the right hand embryo of the figure, the large mesoblast lies between the inner and outer layers, and has already given rise to a number of cells, *mes*, the beginning of the mesoderm. In other cases it has been said that the mesoderm arises from the ectoderm or the entoderm, but nearly every observer is contradicted by some other, therefore it would be unprofitable for us to pursue the matter further. Suffice it to say that the embryonic mesoderm of the Bilateralia consists of a *mass* of cells, or of *several strata* when the mass is compact, whereas the other two layers are each but one cell thick. This difference is always preserved, except in the ectoderm of vertebrates, to which we shall recur. This is our third law.

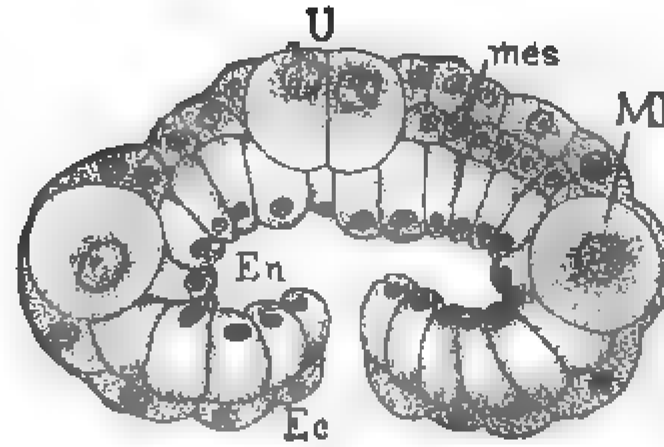

FIG. 21.—Double embryo of *Lumbricus trapezoides*, longitudinal section. After Kleinenberg.

The fourth law is that the cells are grouped in definite relations to certain ideal axes or planes. The first of these axes is the *gastrula* or *dorso-ventral*; it alone is clearly indicated in the Cœlenterata. It is the line which passes through the mouth of the gastrula and the opposite end of the body, Fig. 22 *A*.

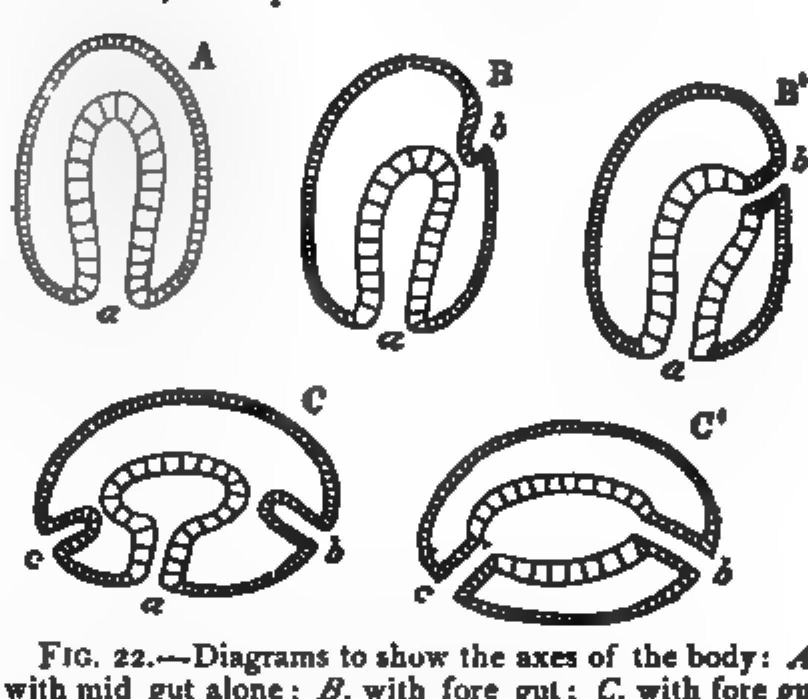

FIG. 22.—Diagrams to show the axes of the body: *A*, with mid gut alone; *B*, with fore gut; *C*, with fore gut and hind gut; *a*, opening of gastrula; *b*, of fore gut; *c*, of hind gut.

In order to understand the relation of the other axes, we must consider briefly the development of the digestive canal in the Echinoderms, and some bilateral animals. The diagrams in Fig. 22 show the points which concern us now. The ectoderm in the young Echinoderm gastrula forms a little pit, Fig. 22 *B*, *b*, near the upper end of the gastrula stomach; the bottom of this pit grows onto the wall of the stomach, an opening breaks through and the pit and the stomach form a continuous canal with two orifices, Fig. 22 *B'*. A plane passed through these two openings and through the gastrula axis will divide the body into symmetrical halves, a right and left. This plane may be called the median plane. It is of course purely ideal, not present as a structure of the embryo. In the young mollusk, a snail for instance, beside the first ectodermal pit, Fig. 22 *C*, *b*, there is formed a second one, and always in such a position that the median plane passes through it, while the gastrula mouth lies between the two involutions of the ectoderm. The gastrula mouth ultimately closes, the two pits become connected with the entodermal cavity, their exterior openings forming respectively the mouth and the anus. A line passed through these two secondary openings represents the longitudinal or antero-posterior axis. It must not be imagined that these axes necessarily always remain straight, for, on the contrary, they usually depart somewhat from the simple form, sometimes very much so, as in the case of the spirally twisted snails. These axes mark the distinction of dorsal and ventral surface, of right and left sides, of anterior and posterior ends or head and tail. In the vertebrates the axes are further complicated in a manner which will be studied in a special article, and is therefore passed over here.

The fifth law is that, however much the weight of an animal increases during its development, the ratio of the free surfaces to the mass alter but slightly from the ratio established when the embryo begins to take food from outside. It is only for convenience that I express this law in this precise form—in reality, about it our knowledge is scanty and our conceptions vague. According to a geometrical principle, when the bulk of a body bounded by a simple surface increases, the surface enlarges less than the mass—in the simplest case of a cube, the surface increases as the square, the mass as the cube of the diameter. If in a cube of unit diameter, one unit of surface bounds one unit of mass, then

in a cube of three units diameter, *nine* units of surface will bound *twenty-seven* units of mass; the proportion in the first cube is 1 : 1, in the second 1 : 3. To maintain the proper proportion in the embryo, simple enlargement is insufficient, therefore the surface becomes more and more irregular or uneven, being thereby multiplied to correspond with the bulk. The irregularities present distinctive peculiarities characteristic of each organ and part, and may be either large or microscopic. They may be conveniently classified under five heads: 1. Projections, either large like the limbs of insects and quadrupeds, the tentacles of Cœlenterates, the branchia of Amphibia, etc., or microscopic like the *villi* of the intestine.[1] 2. *Dilatations* of the digestive canal and other internal cavities; the stomach is usually a dilation. 3. *Diverticula*, or blind pouches, pushing out from one part or another; the lungs of vertebrates, for example, are diverticula of the digestive tract. 4. *Folds*, or ridges either longitudinal or transverse. A capital illustration is afforded by the common grasshopper (Caloptenus); this insect has six large diverticula springing from the front end of its stomach, each of which is traversed by twelve longitudinal folds, admirably shown in transverse sections, Fig. 23. 4. Small pits, or *invaginations*, which form glands. They differ from diverticula by their smaller size, and also in that they grow *into* the mesoderm, while the diverticula push the mesoderm along with them. A section through a couple of such pits is shown in Fig. 24, which represents "mucous glands" from the stomach of a kangaroo. It will be noticed that the cells at the bottom of the pit are larger than those nearer its mouth, so that the lower *glandular portion* is already marked off from the upper part or *duct*. Of *pits*, or *glands* as they are prop-

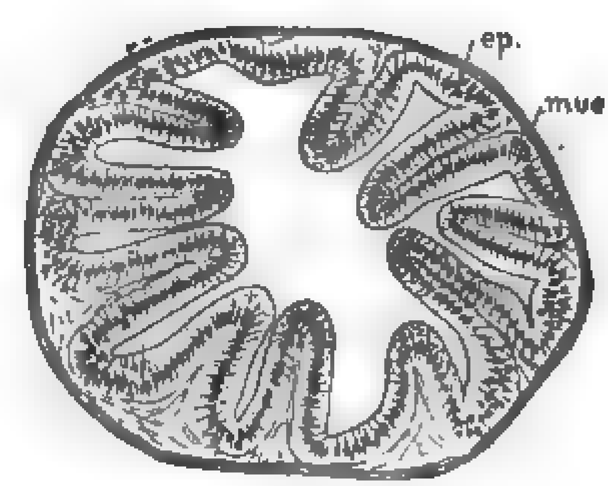

Fig. 23.—Transverse section of gastric cœcum of *Caloptenus spretus*; *ep*, entodermal epithelium; *muc*, muscles; *conn*, connective tissue. × about 40 diam.

[1] To see the *villi*, of which students usually have a very imperfect conception, it is only necessary to take a short piece of small intestine of a common mammal (dog or rat), slit it lengthwise, spread it out, wash it and examine with a lens. Although the inner surface of the intestine would be very small if it were smooth, yet in reality it is very great, being increased by the countless villi and glands.

erly called, there are many kinds, varying in shape and in the character of the cells lining them. They may be straight or very much elongated and coiled or twisted; they branch in many different ways, but all forms are modifications derived from simple pit-like invaginations.

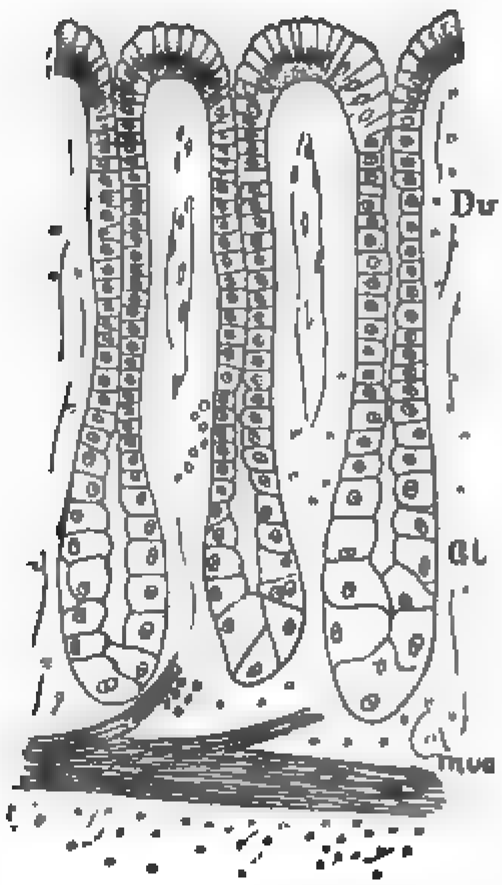

FIG. 24. — Vertical section of mucous glands from the stomach of *Macropus giganteus*. After Schaefer. × 210 diam.

The necessity of proportioning the surface to the mass arises from the fact that it is only through the surface that food, water and oxygen can be taken in, refuse matters (excretions) ejected, and sensations from the outside received. Hence when the right relation is once established it must be permanently kept up. In the growing embryo the object is so to expand the surface that as the bulk increases, the surface is always sufficient not only to supply the cells composing it, but also the inner and deeper lying tissues.

We can now understand why eggs with very little yolk are hatched very early, to become self-dependent larvæ—it is because of their small bulk, which enables a simple surface to answer their physiological needs, to digest and breathe enough. Bulkier eggs must reach a more advanced development, living the while on their own yolk, before they can lead a free life. Let it not be thought, however, that any one has ever determined, even in a single case, the proportion between the surface and the mass. There are reasons for thinking that the proportion varies considerably in different species, and even in individuals of the same species.

The sixth law is, that in all but the lowest metazoa, there are several systems of cavities formed in the mesoderm. The mesoderm becomes more important and voluminous as we ascend the animal series, and so also do the cavities of the middle layer become more complex. In many animals there is one large space known as the body cavity, but the other spaces are for the most part small; such are the organs of the circulation, the blood ves-

sels, and in vertebrates the lymphatic system. Another set of cavities forms the excretory system—the water vessels (of certain worms), the segmental organs and kidneys, all distinguished by being connected directly with the exterior by openings through the ectoderm. There are also tubular ducts which compose the secondary genital apparatus, and are, in many of the higher invertebrates and in all vertebrates, intimately connected with the excretory organs. Formerly it was supposed that the branching respiratory tubes or *trachea* of insects, were mesodermic, but more recent investigations tend to show that they are always invaginations of the ectoderm. All these cavities are lined each by a layer of cells, one row deep, an *epithelium*. In the circulatory channels and body-cavity, the epithelium appears to be invariably composed of broad, irregularly polygonal very thin cells, being a so-called pavement epithelium, while in the excretory tubes and genital ducts the epithelium is quite thick, each cell being at least as high as it is broad.[1]

The seventh law is of the utmost importance—each germinal layer forms predetermined special tissues, and no others, and each tissue in a predetermined position. In all bilateral animals at least, the mesoderm forms, besides the organs belonging to it exclusively, such as the heart, etc., layers of tissue around the whole entoderm and ectoderm; for example, the intestine of an adult animal is composed of an entodermal lining (epithelium) and several mesodermic coats (connective tissue and muscles); the skin is composed of an outside *epidermis*,[2] derived from the ectoderm, and under it the *dermis*, or cutis, derived from the mesoderm. An organ is said to be ectodermal or entodermal when the part essential to its physiological function arises from one or the other of the primitive layers; for example, the eye is ectodermal because its light perceiving portion is developed from the outer germ layer; the liver on the other hand is entodermal because its secreting cells are formed from the inner germ layer.

The anatomy of adult forms does not by any means always reveal to which layer a given organ properly belongs. This is perhaps better illustrated by the nervous system than by any

[1] There are certain exceptions, *e. g.*, the malpighian bodies of the vertebrate kidneys are lined by a pavement epithelium although they form part of the excretory system of cavities.

[2] Often called *hypodermis* by many writers on Invertebrates, especially by entomologists.

other structure. In nearly all animals the central nervous system (nerve ganglia, spinal cord, etc.) lies quite deep, well separated from the ectoderm or skin, yet in the embryo the nervous system arises from the ectoderm (Fig. 25, *cf.* also Fig. 20) appearing at first as cells very much like the rest of the ectoderm. They soon, however, separate from their first neighbors, moving inwards; the mesoderm then grows in between the half developed nervous cells and the ectoderm, so that they are completely divided.

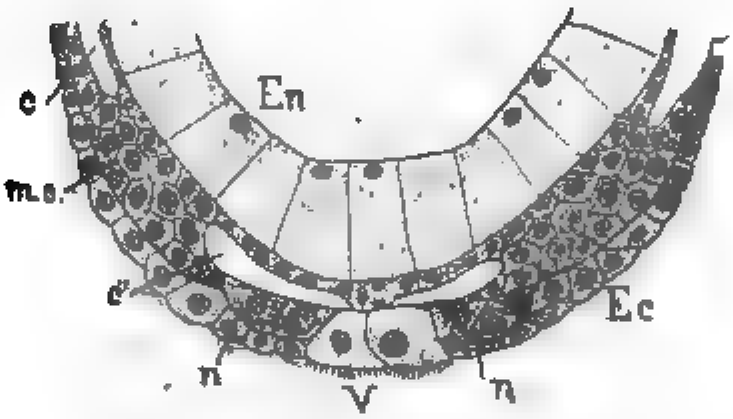

FIG. 25—Transverse section of embryo *Lumbricus trapezoides*. After Kleinenberg. *En*, entoderm; *Ec*, ectoderm; *n*, *n*, beginning of nervous system; *v*, ciliated band separating the two parts of the nervous system; *c*, *c'*, parts of body cavity; *m.c.*, mesoderm. Only the ventral half of the section is figured.

The following table shows to which of the germ layers the principal organs belong:

ECTODERM.

1. Epidermis or external skin.
   The crust of arthropods.
   Shell of mollusks.
   Horns, hairs and nails.
   Cutaneous glands.
   Cilia of larva, etc.
2. Nervous system.
   Organs of, *a* Touch.
   b Taste.
   c Smell.
   d Hearing.
   e Sight, etc.
4. Fore gut.
5. Hind gut.
6. Mouth gut (vertebrates).
7. Gills.
8. Tracheæ of insects.

MESODERM.

1. Wandering cells.
2. Connective tissue, fat cells, etc.
3. Internal skeleton.
4. Muscles.
5. Genital products.
6. Blood.
7. Organs of circulation.
8. Organs of excretion.
9. Secondary genital organs.
10. Lymphatics (and spleen).

ENTODERM.

1. Middle gut.
2. Liver.
3. Lungs.
4. Glands.
   Thyroid, pancreas, etc.
5. Various appendages of the digestive canal.

As appears from this table the destiny of each germ layer is predetermined.

The eighth law is, that the simple cells formed during segmentation change their character during embryonic growth, not only appearing differently but altering also their activity from general

to special functions. Of course it is not possible to consider here in detail the laws of histological differentiation, the more as they have never received much attention, for although hundreds of published researches elaborately describe the changes in special cases, yet the general laws of the progressive development of cells have never been seriously discussed, and rarely subject to more than incidental treatment. I shall mention only three general principles, which are at once universally applicable and readily understood. 1. Structural modifications of epitheliums usually affect similarly a whole cluster of cells; or 2. Less frequently isolated cells only. 3. The mesodermic tissues are for the most part in masses (muscles, tendons, fat, etc.) not in layers, excepting always the epithelial lining of the mesodermic cavities.

We have already considered one illustration of the first principle, the formation of the central nervous system (Fig. 25, *n*, *n*). Other areas are transformed into the retinæ, the finger nails, etc. Again smaller clusters into the lining of glands. Let us consider for a moment the peptic glands of the mammalian stomach, which are modifications of the simpler mucous glands (Fig. 24). The peptic gland is still a straight tubular pit running down from the inner surface of the stomach, but the cells composing its walls are of several kinds—one sort in the neck, *a*, two in the glandular portions, *b* and *c*, of which the darker and more closely granulate cells ("*Belegzellen*") predominate in *b*, but the lighter central cells, *h* ("*Hauptzellen*"), in *c*. The central cavity of the gland is not shown in *b* and *c*. The relative positions of the two kinds of cells will perhaps be better understood by a transverse section, Fig. 27, through the lower part, Fig. 26 *c*, of a cluster of glands, such a section being of course parallel to the inner surface of the stomach. We here have an excellent illustration of what is meant by histological differentiation, for the general arrangement of the cells is the same as in Fig. 24, but in different parts of the more complex peptic gland they have assumed distinct forms and functions.

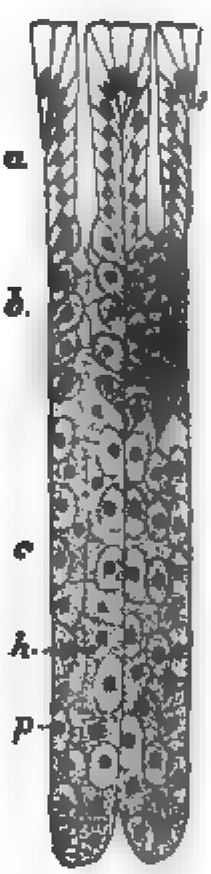

FIG. 26.—Peptic glands from stomach of guinea pig; *a*, neck; *b*, middle portion; *c*, basal glandular parts; *h*, "hauptzellen;" *p*, peripheral cells. After Rollet. × 160 diam.

The differentiation of isolated cells is often very important. In

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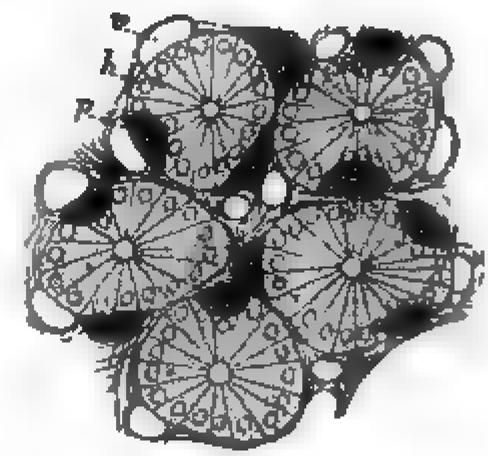
FIG. 27. — Transverse section across five peptic glands of a domestic pig; *v*, blood vessel; *h*, "hauptzellen;" *p*, peripheral cells. After Rollet. × 320 diam.

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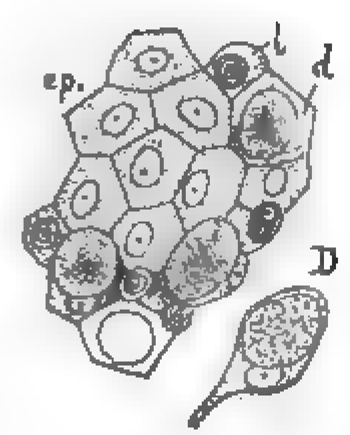

FIG. 28.—Ectoderm of Tetrapteron; *ep*, modified epidermis; *l*, lasso or nettle cell; *d*, gland cell. *D*, side view of gland cell. After Claus.

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The metric system is extensively used in this country, but not yet so generally as would seem to be desirable. While its introduction into scientific work is quite general, its use in mechanics and manufactures makes slow progress. This is natural, but we believe that the merits of the system will become so obvious as ultimately to command the support of all who use measures of any kind. It is evident that such a radical change can only be made slowly, and be introduced under special circumstances, as, for instance, in the commencement of new manufacturing or engineering enterprises. Old institutions with extensive apparatus, would be involved in expense in changing their scales, and in difficulty in instructing their employés. But we cannot on this account endorse the opposition which has been displayed in some quarters. The fact that it may cost a given firm of manufacturing machinists so many thousand dollars to alter their measuring tools, does not justify those persons in resisting the general introduction of the system. The objection now most dwelt on, that the metre is not exactly what it professes to be, has, in our judgment, little bearing on the present state of the case. What the world wants, and sooner or later will have, is a uniform decimal system of weights and measures. This it has in the metric system, and its adoption has now proceeded so far that it is useless to think of proposing or creating another to take its place.

We hope that the time is near at hand when a uniform decimal system of coinage will be adopted by civilized governments. It will be much more readily introduced into common use than the changes contemplated by the metric system.

—— It has been demonstrated beyond all doubt that the Permanent Exhibition of Philadelphia can pay its running expenses. Even in its present inchoate condition it supplies a need, and is popular with a large class of citizens. But it remains to put into execution the classified museum scheme which was adopted two years ago, and before this is done provision must be made for necessary repairs to the roof and floor of the building. The former requires attention, but the condition of the floor is more serious. It is to be hoped that the subscription now on foot in

this city to raise a fund to secure these repairs, will be suc
Then it will be seen whether the Board of Directors will
the importance of the work cut out by the Council of Edu
and will really grant to that body the privilege of carry
the programme they have presented. Unless this is ful
frankly done, the Board of Directors may rest assured tha
labors, which have been neither few nor light, will have
wasted, and that the Exposition will be a failure. The C
of Education is composed of capable men, and such as w
be found to repeat their past work unless their relations
Exposition are placed on a permanent and satisfactory bas

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RECENT LITERATURE.

THE TARSUS AND CARPUS OF BIRDS.[1]—In his first pape
Morse gives the results of his examination of the embr
various North American birds, with reference to the pr
constitution of their tarsus and carpus. In the former h
three bones, *tibiale*, *fibulare* and *centrale*. The first two uni
an hourglass-shaped bone such as exists among Dinosau
astragalo-calcaneum, while the last forms the cap for the m
sals, contributing to the adult tarsometatarse. In the
Prof. Morse finds four bones (rarely five), of which two b
united with the ulno-radius, and two or three with the m
pals. He then introduces the description of a fourth tarsa
found by Prof. Wyman in the "blue heron," and mentior
him in a letter. Prof. Morse concludes that this element
intermedium of Gegenbaur somewhat out of place. In his
memoir, the author further investigates this fourth tarsal a
homologues. His studies having been directed to the
birds, as penguins, auks, petrels, etc., he finds the ascendin
partly occupying the position of the intermedium in sev
them. He finds that it early unites with the tibiale and fi
forming a temporary *astragalo-calcaneum*, which thereafter
with the tibia. He is thus able to homologize the ascendir
cess of the *astragalo-calcaneum* of *Ornithotarsus* and *Lælaj*
the intermedium. In the course of his examinations
manus of the sea pigeon, Prof. Morse found curious apical
sions of the distal phalanges.

We have been much interested in this essay, and cor
it as a good illustration of the meaning of the term *monogr*

[1] *The Tarsus and Carpus of Birds.* By E. S. MORSE, Ph. D. Annals
New York, 1872.

*The Identity of the Ascending Process of the Astragalus in Birds with t
medium.* By E. S. MORSE, Ph.D. Anniv. Mem. Boston Soc. N. History. 18

A MANUAL OF THE INFUSORIA.[1]—The first installment of 144 pages of this work impresses us with the belief that the English reading student who desires to become acquainted with the remarkable animals of which it treats, should take early measures to secure a copy. The execution of the work, both as to illustrations and text, is excellent, while its size is convenient for actual students. The author introduces us to the objects of his studies in a highly agreeable manner, rendering even the details of the history of their successive discovery interesting. The scientific results are important, including some systematic views which will at least aid in the analysis of the forms included in the class. Thirteen divisions are recognized which fall into four orders, viz: the *Pantostomata*, *Discostomata*, *Eustomata* and *Polystomata*.

Mr. Kent devotes a chapter to spontaneous generation, and we make some extracts treating of this obscure and interesting subject.

"The general conclusions deducible from the long array of evidence now produced with respect to the question of 'spontaneous generation,' or 'abiogenesis,' may now be briefly summarized. From every line of inquiry investigated, one and the same answer is invariably returned. Life in its most humble and obscure form, be it existent as impalpable germinal dust floating in the atmosphere, or shaken from a truss of hay, or manifested in its more active state as the minute monads, bacteria and other organisms developed in infusions, tells everywhere the same unvarying tale. Traced backwards to its origin, or forwards to its ultimate development, each type is found by patient search to be derived, not *de novo* out of dead or inorganic elements, but from a specific parental form identical in all respects with itself, and whose life-cycle is as true and complete as that, even, of man himself. * * *

"In order to arrive at a comprehensive insight into the life phenomena and progressive developmental manifestations of the special group of infusorial animalcules now under consideration, hay from different localities was placed in maceration and examined continuously, from its first contact with the fluid medium, for periods varying in duration from a few days only to several weeks. The water added to the hay was of the purest possible description, and was frequently boiled for some time to prevent the introduction of extraneous germs. In all instances the results obtained were broadly and fundamentally the same, and differed only with respect to the specific types found living together in the separate infusions. Even here, however, the general dominance of two or more special forms was notably apparent. Commencing with the first wetting and simultaneous examination of any given

[1] *A Manual of the Infusoria;* including a description of all known Flagellate, Ciliate and Tentaculiferous Protozoa. By W. SAVILLE KENT, F.L.S. Roy. 8vo. London, David Boyne, 1880.

sample, spores of different sizes were found congregated in coun
less numbers and in various orders of distribution throughout t
surfaces of the vegetable tissues. The majority of these spor
were excessively minute, spherical, of the average diameter of t
1–20,000th part of an English inch, and required necessarily t
employment of the highest powers of the compound microsc
for the correct registration of their characteristic form and si
Sometimes these spores were to be observed collected in defin
spherical heaps, but more often they were scattered in irregu
shaped patches, such patches being often again more or less co
fluent, and thus forming collections of considerable extent.
large number of these spores were likewise to be seen, detach
from their original adhesions, freely floating in the water or c
lected in masses upon the peripheries of the small air bubbles t
had here and there become entangled between the slide and co
ering glass. In this latter instance the spores exhibited a thick
and more opaque bounding wall, and manifested, as in the ca
of lycopodium powder, the power of resisting for some time t
hydrostatic or wetting action of the water: this property h
already been suspected by Prof. Tyndall to be possessed by the
minute bodies, but had not previously been practically demo
strated.

"The hay within from four to six hours after maceration reveal
on examination of a small fragment, a considerable alteration
the character and comportment of the associated spores. Hit
erto these had displayed no signs of motion, a uniform stilln
reigning throughout the entire expanse of the microscopic fie
Now, however, among the numbers that had become detach
from their original adhesion to the vegetable matter, the majori
exhibited an active vibratory motion that at first sight w
scarcely to be distinguished from the characteristic 'Browni
movements.' The size of these motile spores corresponded wi
that of the quiescent ones, not exceeding the 1–20,000th of
inch in diameter, and without recourse to the highest magnifyi
power and the most careful adjustment of the illumination, it w
not found possible to ascertain by what means their locomoti
was accomplished. Examined successively with the $\frac{1}{16}$, $\frac{1}{25}$ a
$\frac{1}{50}$ inch objectives of Messrs. Powell and Lealand, it was
length satisfactorily determined that each individual spore
body was furnished with a single, long, slender, whip-like org
or flagellum, whose active vibrations propelled the spherical bod
through the water. These minute motile corpuscles exhibited,
fact, at this early stage of their development a type of organiz
tion in all ways comparable with that of the simply uniflagella
genus Monas."

PACKARD'S ZOOLOGY, SECOND EDITION.[1]—In revising this te

[1] *Zoology for High Schools and Colleges.* By A. S. PACKARD, Jr. Second editi
revised. New York, Henry Holt & Co., 1880. 12mo, pp. 719. $3.00.

book, the author has availed himself of the criticisms of other naturalists, and thus made a considerable number of changes in the stereotype plates. Several of the figures, notably that illustrating the anatomy of the cat, have been changed, and one of the opossum and its marsupial bone added. Other changes have been made in order to bring the book up to the present state of the science.

DAUBREE'S CHEMICAL GEOLOGY.[1]—This grand work may be regarded as a revised collected edition of the former smaller papers of M. Daubrée on experimental geology. It may be regarded as the great work of M. Daubrée's most laborious and successful scientific life, and on it he may safely rest his fame.

The first section of the work deals with chemical and physical phenomena—metalliferous deposits, nature of metamorphism, the effect of heated waters, formation of zeolites, amygdaloids, rocks both eruptive and metamorphic, and volcanic action.

The second section treats of mechanical phenomena, and applies the rigid experimental method of trituration and transportation of sediments, and chemical decompositions by mechanical forces; the distribution of gold in the bed of the Rhine is also discussed. The first chapter contains an account of the experiments on the striation of rocks. The marks or striæ are produced or imitated by rubbing pebbles together. The second chapter treats of the deformations which the earth's crust has been subjected to in former ways. Sir James Hall's experiments were of a similar character. The remarkable examples of reversed folds, as shown in the Alpine regions, are imitated and explained. The discussion of the nature and causes of faults, joints and all kinds of fractures in sedimentary rocks will be read by the geologist with peculiar interest. The account of the experiments on the heat developed by the crushing, grinding and mutual frictions of rocks are important; it is believed that sufficient heat may be generated in this way to produce metamorphism.

The second part treats altogether of cosmic bodies. Three hundred and fifty pages are devoted to the experimental study of the structure and genesis of meteorites and the accompanying minerals. The entire volume is well illustrated, and as a specimen of typography may be regarded as a model of clearness and beauty.—*F. V. H.*

HERTWIG'S CHÆTOGNATH WORMS.[2]—A careful elaboration of the morphology and development of the Sagitta, the type of the Chætognathi, that singular type of worms, so aberrant that it has

[1] *Etudes Synthetiques de Geologie Experimentale.* Par A. Daubrée. Premiere partie—Application de la méthode experimentale a l'etude de divers phenoménes geologiques. Deuxieme partie—Application de la méthode experimentale a l'etude de divers phenoménes cosmologiques. Large 8vo, 828 pages.

[2] *Die Chætognathen. Ihre Anatomie, Systematik und Entwicklungeschichte.* Eine Monographie. Von Dr. OSCAR HERTWIG. Mit 6 Tafeln. Jena, 1880. 8vo, pp. 112.

by different authors been regarded as a vertebrate, a mollusk, as well as a crustacean, has been greatly needed. Dr. Oscar Hertwig is so excellent a histologist and anatomist, that we may feel sure that this investigation has been made with the same exactitude which has characterized his previous labors on the lower animals. Our knowledge of Sagitta had already been greatly extended by the researches of Krohn and Kowalevsky, and owing to the results reached by them, no one now doubts but that Sagitta is a worm (Vermes), though its place among the classes of Vermes is uncertain. Hertwig concludes that it agrees best with the Nematodes and Annelides.

WADSWORTH'S GEOLOGICAL PAPERS.[1]—These papers by Prof. Wadsworth are, like all the preceding writings of this author, of the most thorough character. He has made the microscopic study of igneous and metamorphic rocks a special study for several years, and by his thoroughness has elevated this department of geology very nearly to an exact science. The first paper, on the geology of Lake Superior, is the most important one, and contains six effective octavo plates, showing the relations of the different kinds of rocks to each other; the dykes, bands of iron ores, jasper veins, felsites, diorites are clearly shown in their relations to each other in the rock masses. Mr. Wadsworth has not relied on the microscope alone, but has given many important chemical analyses of minerals. The historical account of the explorations of others in that region, with the bibliography at the end of the memoirs, is very valuable. We wish we could quote largely from these papers, but space will not permit.—*F. V. H.*

PHYSICAL AND GEOLOGICAL RESULTS OF THE FRENCH EXPEDITION TO OBSERVE THE TRANSIT OF VENUS.[2]—These beautiful volumes are a portion of the results of the French Expedition to observe the Transit of Venus. The first part deals with the physical results of the expedition, printed in fine clear type with eighteen excellent plates, a portion of them photographic. The

[1] *Notes on the Geology of the Iron and Copper Districts of Lake Superior.* By M. E. Wadsworth. Bulletin of the Museum of Comparative Zoölogy at Harvard College, Whole Series, Vol. VII. (Geological Series, Vol. I). pp. 157, with 6 plates.

On the Elongation and Plasticity of Pebbles in Conglomerates. By M. E. WADSWORTH. (From the Proceedings of the Boston Society of Natural History, Vol. XX, Nov. 5, 1879.)

Danalite from the Iron Mine, Bartlett, New Hampshire. By M. E. WADSWORTH.

Picrolite from a Serpentine Quarry in Florida, Mass. By M. E. WADSWORTH.

[2] *Mission de l'Isle Saint-Paul Observations Astronomiques, operations photographiques, observations magnetiques et hydrographie.* Institut de France. Academie des Sciences. Recueil de memoires a l'observation du passage de Vénus sur le Soleil. (Extrait du tome II, 1st partie.) 425 pp., 4to, 18 plates and maps.

Recherches Geologiques faites, a Aden, a la Reunion, aux Isles Saint Paul et Amsterdam, aux Seychelles. Par M. CH. VELAIN, Maitre de conferences a la Sorbonne. 460 pp., 4to, 25 plates and maps. (Extrait du tome II, 2d partie.) Paris, 1879.

engravings are good, showing with great detail the surface features of the island, pictorially and topographically. But to the naturalist and geologist, the second part, by M. Velain, is of greater interest. This volume is illustrated with twenty-seven quarto plates, eight of which are by the photoglyptic process, and are microscopic studies of the volcanic rocks. The island itself is of volcanic origin, and entirely composed of igneous rocks. This volume is a most elaborate monograph of the mineralogical and structural history of the island, by means of sections and colored maps, and it certainly is a model of careful study and bookmaking. Many actual volcanoes are shown to exist on the island, in operation at the present time. The publication of these important volumes is very creditable to the Government of France as well as to the authors.

M. Velain has recently published a small brochure of great interest in Bulletin No. 7 of the Mineralogical Society of France, on the microscopic study of the glass or slag resulting from the fusion of the ashes of grasses. It is illustrated with an excellent octavo plate showing the production, artificially, of the crystals of tridymite, anortheite, wollastonite and augite.—*F. V. H.*

SIGSBEE'S DEEP SEA SOUNDING AND DREDGING.[1]—It is greatly to the credit of American science and to our government, that it has taken so prominent a part in deep sea explorations. This is due largely to the labors and energy of the lamented Count Pourtales, who was a distinguished physical geographer and for a long time an assistant in the U. S. Coast Survey. He was the first to show that the warmer waters of the tropics, notably the Floridan seas, with their profusion of tropical life, were underlaid by a colder bottom stratum of water with a nearly equal profusion of what was hitherto supposed to be purely Arctic life. The Norwegian marine zoölogists had previously demonstrated the existence of a deep-sea fauna off the coast of Norway, and the Swedish naturalist, Lovén, had suggested that this deep sea fauna was widespread over the ocean bottom, but Pourtales demonstrated it, and the subsequent deep sea explorations of the English Navy, especially the Challenger Expedition, carried out and extended Pourtales' discoveries.

Pourtales was aided and advised by his friend Agassiz, and the work of exploration of the ocean bottom under the Gulf Stream off the Floridan peninsula, and in the Gulf of Mexico, as well as off the southern coast of the United States, has of late years been extended by the officers of the U. S. Coast Survey, Mr. Alexander Agassiz being the naturalist of the recent expeditions. The Coast Survey has now a beautiful steamer, the *Blake*, of 350 tons,

[1] *United States Coast and Geodetic Survey.* CARLISLE P. PATTERSON, Superintendent. Deep sea Sounding and Dredging. A description and discussion of the methods and appliances used on board the Coast and Geodetic Survey Steamer *Blake*. By CHARLES D. SIGSBEE, U.S.N. Washington, D. C., 1880. 4to, pp. 192.

built and equipped for the work of deep sea sounding and dredging. The successive officers, Commanders Howell, Sigsbee and Bartlett, especially Commander Sigsbee, have devised the most elaborate and effective machinery for this difficult work, and the present elegant volume gives in great detail the methods and instruments for studying the physics of the sea and for investigating the life of the ocean from the surface to the bottom, even to the abyssal depths; subjects bearing intimately on the physics, geology and biology of the globe. The Superintendent of the Coast Survey, after giving in a prefatory note the history of these undertakings, refers with pride to the fact "that in the small steamer *Blake*, of only 350 tons burthen, n. m., under the energetic and skillful commands of Lieut. Com. Sigsbee and Com. Bartlett, with a full complement of forty-five, including officers and crew, more rapid work was done than had been accomplished with the old methods and appliances by the *Challenger*, a vessel of over 2000 tons burthen, with a complement of twenty-nine naval and civil officers and a correspondingly large crew."

RECENT BOOKS AND PAMPHLETS.—History of North American Pinnipeds. By Joel A. Allen. (Dep. Int., U. S. Geol. and Geog. Surv. Terr., Misc. Pub. No. 12) pp. 785. Washington, 1880. From the author.

Annual Report of the National Academy of Sciences. pp. 22. Washington, 1880. From the academy.

Description of Four New Species and a new variety of Silurian Fossils and Remarks on others. By S. A. Miller. (From Journ. Cincinnati Soc. Nat. Hist. Oct. 1880.) pp. 5, 1 plate. From the author.

The Devonian Insects of New Brunswick. By Samuel H. Scudder. (From Anniv. Mem. Boston Soc. Nat. Hist.) 4to, pp. 41, 1 plate. Boston, 1880. From the author.

Etude sur la Faune Ichthyologique de l'Ogooue par M. H. E. Sauvage. (From Nouv. Archiv. du Museum, deuxieme série. Paris, 1880.) 4to, pp. 55, 3 plates. From the author.

Notice sur les Travaux Scientifiques de Belgrand par M. A. Delaire. 8vo, pp. 20. Paris, 1880. From the author.

Zoologie in Beziehung zur Anthropologie mit Einschluss der tertiären Säugethiere. Von Dr. W. Branco. (From Archiv. für Anthrop., for 1879 and 1880.) 4to, 1880. From the author.

Centralblatt für das gesammte Forstwesen. Heft. 5. May, 1880. 8vo, pp. 6[illegible]. From the editor.

Vorläufige Mittheilung über die Entwickelungsgeschichte der Petromyzonten. Von Dr. W. B. Scott. (Ext. from Zool. Anzeiger, 1880, No. 63 u 64.) 8vo, pp. 7. From the author.

Untersuchungen über die Organization von Cycloclypeus ucarp. und Orbitoides D'Orb. Von. Dr. K. Martin. pp. 24, 2 plates. 1880. From the author.

Untersuchungen über die Organization von Astylospongia Ferd. Roem., und Bemerkungen über die Natur der Wallsteine, Meyer. Von. Dr. K. Martin, Wismar. (Aus dem Archiv. des Ver. der Freunde der Naturg. in Mecklenburg Jahrg. 31.) 8vo, pp. 32, 1 plate. Neubrandenburg, 1877. From the author.

Ichthyologische Beiträge (IX.) Von. Dr. Franz Steindachner. I. Über eine Sammlung von Flussfischen von Tohizona auf Madagascar. II. Über zwei neue Agonus-arten aus Californien. III. Über einige Fischarten aus dem nördlichen Japan, gesammelt vom Prof. Dybowski. (Aus dem LXXXII Bande der Sitzb. der I

Akad. der Wissensch. I. Abth. Juli-Heft. Jahrg. 1880.) pp. 29, 6 plates. From the author.

Topographical and Geological Atlas of the district of the High Plateau of Utah, to accompany Report of Capt. C. E. Dutton. (Dep. Int. U. S. Geol. and Geog. Surv. Rocky Mountain Region.) Atlas, 8 sheets. New York, 1879. From the survey.

Contributions to the anatomy of the genus Pentremites, with description of new species. By Dr. G. Hambach. (From Trans. St. Louis Acad. of Sciences). 8vo, pp. 16, 2 plates. From the author.

Etude Stratigraphique et Paléontologique des Terrains Jurassiques du Portugal par Paul Choffat. 4to, pp. 12, 72. Première Livraison. Lisbon, 1880. From the author.

Mémoire sur les Poissons Fossiles des lignites de Sieblos. T. C. Winkler, pp. 24, 2 plates.

Description de Quelque Restes de Poissons Fossiles des terrains triassiques des environs de Wirzbourg. T. C. Winkler, pp. 41, plate, 5.

Note sur Quelques Dents de Poissons Fossiles de l'oligocene inférieur et moyen du Limbourg. Par T. C. Winkler. pp. 12. (Three Extracts of the Archives de Musée Teyler, Vol. v, Livr. 2). Harlem, 1880. From the author.

Anales del Museo Nacional de México. Tome 2. 4to, pp. 57, 3 plates. From the museum.

Spolia Atlantica. Bidrag til Kundskab om Formforandringer hos Fiske under deres Væxt og Udvikling særligt hos nogle af Atlanterhavets Hjsfiske af Dr. Chr. Lütken. (Ext. Vidensk. Selsk. Skr. 5. Række, natur. og math. Afd. XII, 6). 4to, pp. 198, 5 plates. Copenhagen, 1880. From the author.

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GENERAL NOTES.

BOTANY.[1]

THE BOTANY OF A CITY SQUARE.—Manhattan Square, in New York city, comprises a desolate and broken area of eighteen acres on the west side of Central Park, at Seventy-seventh street and Eighth avenue. It presented, a year ago, the appearance of a basin with an irregular marginal shelf of higher ground and with a ridge of gneissoid rocks running in from its south-eastern corner, upon whose summit stood the American Museum of Natural History. It was otherwise varied by artificial mounds formed of huge gneiss blocks split and blasted off from the original hill which rose up where the museum now stands, and its sides, in many places presented steep banks formed from similar fragments confusedly heaped up in precipitous and jagged piles. The lowest part of this ground was covered by a stagnant pond whose periodical putrescence became both offensive and dangerous. With the bare shoulders of rock protruding in naked bosses here and there, the general aspect of the square was particularly forlorn and unfortunate. The complaint of the health officers in conjunction with a revival of the original intentions to make this spot an appropriate outlier of Central Park, both healthy and attractive, resulted in some municipal efforts to secure these ends. Earth was carted in, the sightless slopes of stone were covered over, the pond filled up, the bare tables of rock hidden, and an attempt made to change the abrupt and angular outlines into

[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

smooth and graceful contours. Whether the results secured were at all proportionate to the time and money expended, is one of those public problems whose solution is best referred to the professional politician. Certainly one result, not aimed at, was to introduce into the square an army of plants whose luxuriant and rapid growth soon covered it with a mantle of waving weeds. Curious to ascertain how many plants flourished upon this limited and forbidding area, the author, at such times as he was at liberty to collect them, began a systematic search over it, and although conscious that want of time interfered with its completeness, yet its extent has caused some surprise, and may prove of interest to a wider circle of students and collectors.

It may be premised for the information of those to whom Manhattan Square, in New York city, is a *terra incognita*, that the immediate district about it is a representative purlieu of a great city, where clusters of shanties alternate with half-finished blocks of handsome houses or stores, the whole a transition phase to a larger and denser population. Not twenty blocks away the closely built up blocks of the city are seen, and Manhattan Square itself may soon be surrounded by sandstone and marble dwellings, and every trace of vegetable existence, except such as shall distinguish or decorate it, be exterminated. The semi-alluvial bottoms of some of the pit-like depressions, and the fertile blanket of soil lying over the low swells of rock in the neighborhood, have been appropriated by squatters for kitchen gardens, and assume in summer an almost rural aspect. The following is a catalogue of the plants collected in Manhattan Square, New York city, in the summer of 1880:

Ranunculaceæ.

Ranunculus acris.

Cruciferæ.

Sisymbrium officinale,
" canescens,
Brassica nigra,
Capsella bursa-pastoris,
Lepidium virginicum.

Hypericaceæ.

Hypericum perforatum.

Caryophyllaceæ.

Silene inflata (A. Woodward) 1 specimen,
" noctiflora, one specimen.
Stellaria media,
Mollugo verticillata.

Portulacaceæ.

Portulaca oleracea.

Malvaceæ.

Malva rotundifolia,
Abutilon avicennæ.

Geraniaceæ.

Geranium carolinianum,
Impatiens fulva,
Oxalis stricta.

Simarubaceæ.

Ailanthus glandulosus.

Anacardiaceæ.

Rhus glabra,
Rhus toxicodendron.

Vitaceæ.

Ampelopsis quinquefolia.

Leguminosæ.

Trifolium agrarium,
" pratense,
" repens,
Melilotus alba,
Apios tuberosa.

Rosaceæ.

Potentilla argentea,
" canadensis,
Fragaria vesca,
Rubus canadensis,
" villosus.

Crassulaceæ.

Penthorum sedoides.

Onagraceæ.

Epilobium palustre, var. lineare,
Œnothera biennis.

Umbelliferæ.

Daucus carota.

Caprifoliaceæ.

Sambucus canadensis.

Compositæ.

Vernonia noveboracensis,
Eupatorium perfoliatum,
Aster simplex,
" novæ angliæ,
" ericoides,
" tradescanti,
" multiflorus,
" acuminatus,
Erigeron canadense,
Solidago canadensis,
" nemoralis,
" tenuifolia,
Ambrosia artemisiæfolia,
Xanthium strumarium,
Helianthus annuus,
Bidens cernua,
Bidens frondosa,
" chrysanthemoides,
Leucanthemum vulgare,
Achillea millefolium,
Galinsoga parviflora,
Maruta cotula,
Gnaphalium decurrens,
Antennaria margaritacea,
Cirsium arvense,
" lanceolatum,
Lappa officinalis,
Cichorium intybus,
Lactuca canadensis,
" scariola,
Mulgedium acuminatum,
Taraxacum dens-leonis.

Campanulaceæ.

Campanula rapunculoides,

Plantaginaceæ.

Plantago major.

Bignoniaceæ.

Catalpa bignonioides.

Scrophulariaceæ.

Verbascum blattaria,
" thapsus,
Linaria vulgaris,
Mimulus ringens,
Veronica sp. ?

Verbenaceæ.

Verbena urticifolia,
Verbena hastata.

Labiatæ.

Lycopus europæus, var. sinuatus,
Salvia lyrata, one specimen,
Collinsonia canadensis,
Nepeta glechoma,
Brunella vulgaris,
Scutellaria lateriflora,
Leonurus cardiaca.

Convolvulaceæ.

Convolvulus arvensis,
Ipomæa purpurea.

Solanaceæ.

Solanum nigrum,
Datura tatula,
Datura stramonium.

Asclepiadaceæ.

Asclepias cornuti.

Phytolaccaceæ.

Phytolacca decandra.

Chenopodiaceæ.

Chenopodium urbicum ?	Chenopodium album,
" ambrosioides,	Atriplex patula, var. hastata.
" botrys,	

Amarantaceæ.

Amarantus caudatus,	Amarantus retroflexus.
" albus,	

Polygonaceæ.

Polygonum orientale,	Polygonum pennsylvanicum,
" persicaria,	" dumetorum, var scandens
" hydropiper,	" sagittatum,
" acre,	Rumex crispus,
" aviculare, var. erectum,	" acetosella.

Euphorbiaceæ.

Euphorbia maculata,	Acalypha virginica.

Cannabineæ.

Cannabis sativa.

Smilaceæ.

Smilax rotundifolia.

Cyperaceæ.

Cyperus strigosus.

Filices.

Aspidium spinulosum ?	Onoclea sensibilis.

The great body of the recently introduced plants are made up of the Amaranths, Chenopodia, Ambrosiæ, Atriplex, Polygona, especially *P. orientale*, Erigeron, and Datura. These attained surprising proportions, and both in size and numbers resembled diminutive forests. Many of the wilder species doubtless were here previous to its present occupancy, and the water-loving plants remained in the moist precincts of the old partially obliterated pond. The Gramineæ, about five species, were omitted.—*L. P. Gratacap.*

A Dispermous Acorn.—In a collection of acorns of *Quercus prinus* Linn. var. *monticola* Michx., found near Diamond Hill quarry, R. I., I noticed one much larger than the others, which were all large, even for the species. I put these acorns in a little paper box in a drawer which I keep for such fruits. In a few days the warmth of the room caused it to germinate, when I noticed two radicles protruding. I then removed the acorn to a bit of perforated cardboard above a tumbler of water, and watched the growth. Afterwards I made a dissection and found, as I expected, two equally developed seeds, each separable into its own two cotyledons, as shown by the accompanying figures. It will be remembered that the ovary of the oak is three-celled and six-ovuled, and that in ripening only one cell remains, and this is filled by one seed. Here two have been equally developed. I find in Masters' Teratology the same thing recorded of Corylus, but nothing is said of Quercus, hence it may be well to record this instance. This phenomenon must not be confounded with poly-embryony, or multiplication of embryos in *one seed*, as in Citrus. In this case while we see an abnormality indeed, it

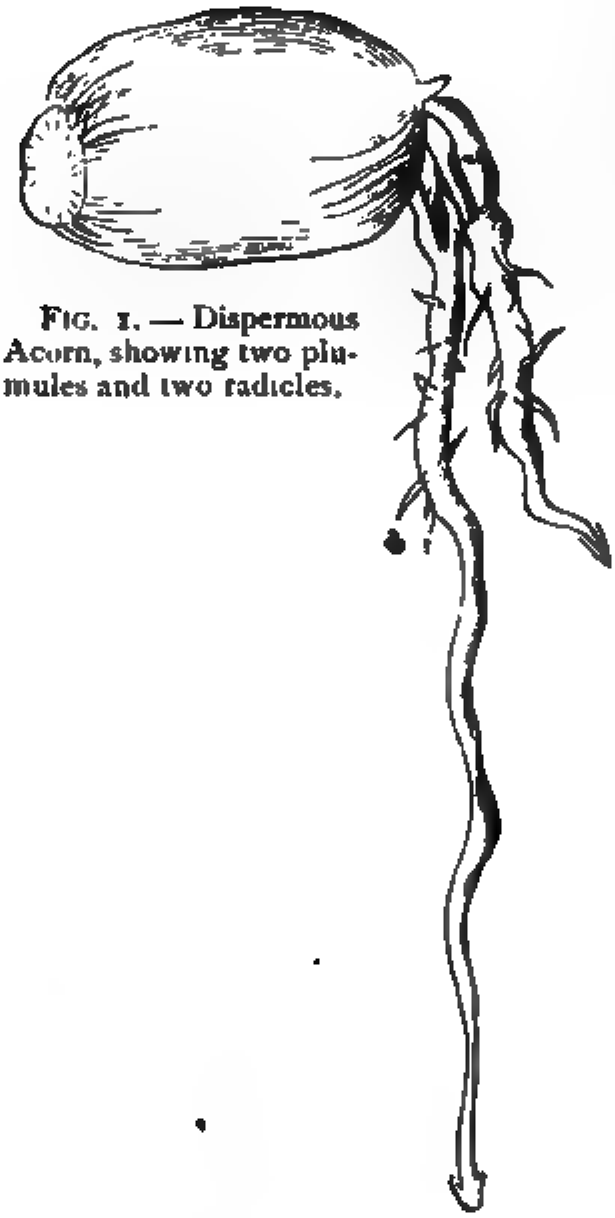

FIG. 1. — Dispermous Acorn, showing two plumules and two radicles.

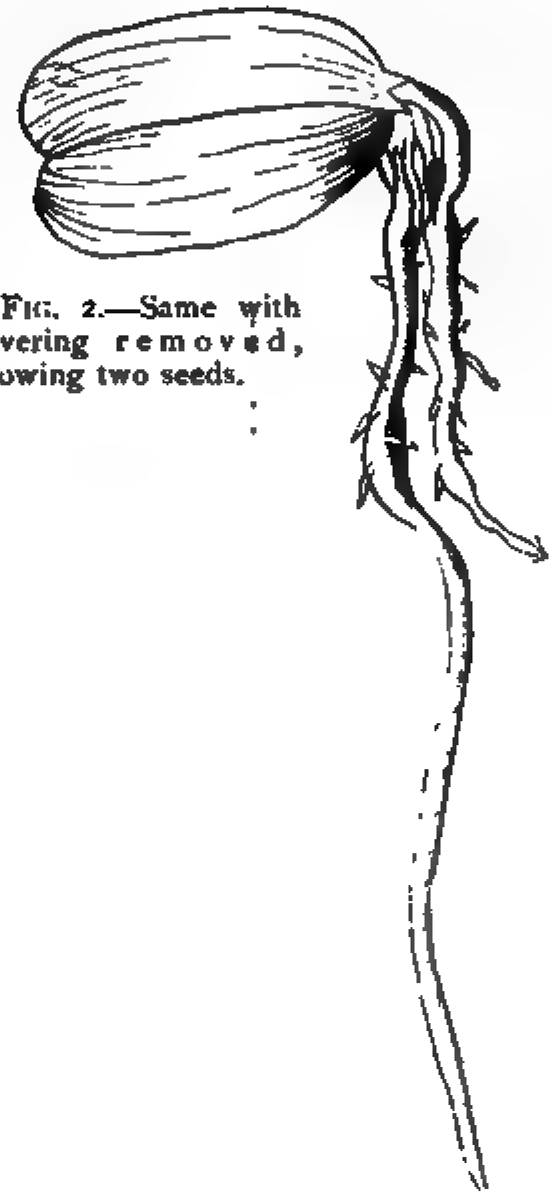

FIG. 2.—Same with covering removed, showing two seeds.

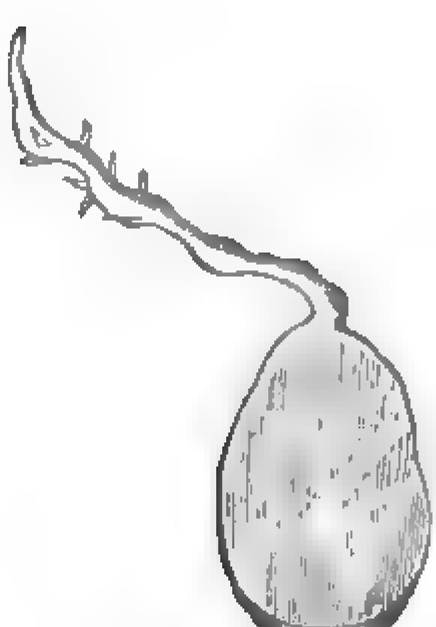

FIG. 3.—One seed removed.

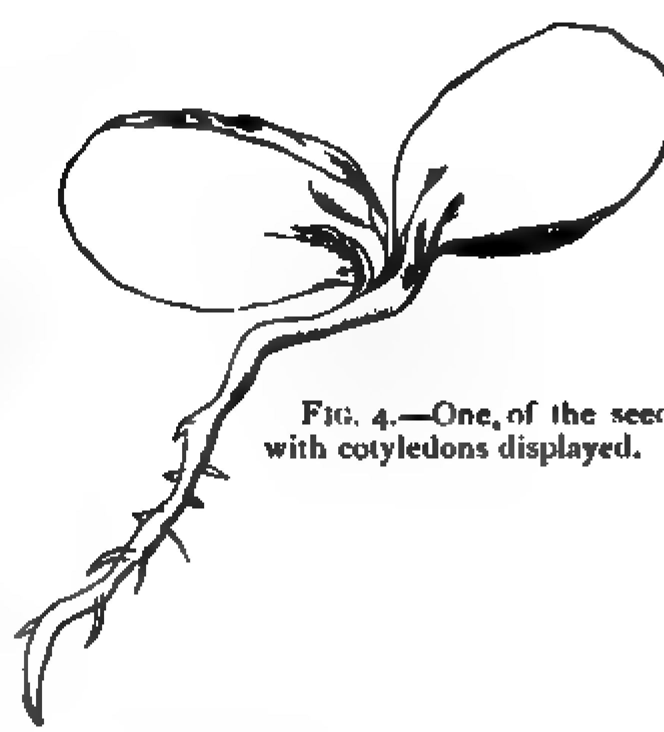

FIG. 4.—One of the seeds with cotyledons displayed.

results merely from the retention in the fruit of some of the parts seen in the ovary, but usually obliterated afterwards.—*W. W. Bailey, Providence, R. I., Oct. 15, 1880.*

BOTANICAL NOTES.—In the prospectus of the *Botanical Gazette* for 1881, the editor takes strong ground in favor of more physiological work, and "would gladly devote half of its space" to papers and notes in this department of Botany. It is to be hoped that the editor may succeed in his laudable undertaking. It certainly is high time that we have a botanical journal in this country devoted entirely to such work.——A very useful "Synoptical Table for the Determination of Fibers of Vegetable Origin" is published in the August-September number of the *Botanical Gazette.* It is from Vetellart's work, "Sur les fibres employes dans l'industrie."——In the September "Torrey Botanical Bulletin," John Williamson contributes a readable account of the "Ferns on the Cumberland." The discovery of *Adiantum capillus-veneris* in Southern Kentucky was confirmed.——A new and enlarged edition of Rattan's "Popular California Flora" has just appeared, from the house of Bancroft & Co., of San Francisco. It will prove quite valuable to the beginners in botany in central California. Many of the more difficult orders, as for example, the Coniferæ, Gramineæ, Cyperaceæ, Salicaceæ, Compositæ, etc. are entirely omitted as too hard for the beginner.——The second volume of the "Botany of California," by Sereno Watson, has just appeared. It will be noticed more fully hereafter.——In the *American Journal of Science and Arts* for October, Dr. Gray briefly notices two recent Swedish contributions to Pomology. One of these records the results of trials made of varieties of apples and other fruits, with a view to determining the northern limit of their hardiness. More than eight hundred varieties were tried, the investigation extending over a period of twelve years. Our American fruit growers would doubtless do well to acquaint themselves with these works.——The more important articles in Caruel's *Nuovo Giornale Botanico Italiano* for July, are by Jatta on the lichens of Central Italy; Macchiati, on the periodical spontaneous movements of the stamens of *Ruta bracteosa* and *Smyrnium rotundifolium* and Cugni on the germination of oily seeds. ——The "Catalogue of Pacific Coast Fungi," by Dr. Harkness and J. P. Moore, published under the direction of the California Academy of Sciences, is a most creditable one. The only other State in the country (for this catalogue is practically confined to California), whose fungi have been as fully catalogued is North Carolina, Dr. Curtis having done for his State in 1867, what the authors of the present catalogue have in 1880 done for theirs.

ZOOLOGY.[1]

THE METAMORPHOSIS OF ACTINOTROCHA.[2]—Schneider first showed that the larva (Actinotrocha) of the Gephyrean, Phoronis,

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A., Washington, D. C.

[2] Abstract of a paper read before the American Association for the Advancement of Science, in Boston, August, 1880.

passes into the adult condition through the development of a deep pouch-like invagination of the ventral body-wall which becomes attached to the stomach, and is at length suddenly evaginated, dragging out into its cavity a long U-shaped loop of the intestinal canal, and thus producing the remarkable flexure of the latter in the adult. This pouch after its evagination forms the greater part of the body; the opposite or dorsal side of the larva becomes much shortened, and is only represented in the adult by the short interval between the mouth and the anus. A study of two species of Actinotrocha occurring in Chesapeake Bay (to be elsewhere more fully described), suggests the following explanation of the significance and origin of this strange metamorphosis:

Considerations which for want of space cannot be here detailed, leave little doubt that the primitive forms among the Gephyrea are those which, like Thalassema or Bonellia, have the mouth and anus at opposite extremities of the body. Forms like Phoronis or Phascolosoma, in which these two openings are near the same extremity, are evidently derivative; in the case of Phoronis, at least, I assume this structure to have been brought about by the flexure of a primitive form into a U-shape (in order, perhaps, to void excrement through the mouth of the tube inhabited by the worm), and the subsequent obliteration of external evidences of this flexure through coalescence of the two parts of the body thus flexed. Such a habit of flexure may be actually observed among some Polychæta and Holothurians; and in the latter case several stages in the obliteration of flexure by coalescence may be observed. The Polychætous larva, Mitraria, affords a further illustration of this point.

Through whatever process we assume the peculiar flexure of the intestine to have been effected, it is clear that the pouch of Actinotrocha, *both before and after its evagination*, is a development of the *ventral* region of the body. And it follows that in the adult the ventral region is greatly in excess of the dorsal, while in the larva they are externally nearly equal. The pouch of the larva is evidently a provision to admit of extensive increase in the ventral region as a preparation for the adult structure, without changing the external form of the body, and thus without impairing the adaptation of the larva to its Pelagic life. Thus the creature is enabled to pass at once, by a single leap, as it were, from one set of conditions to an entirely different set, without having to pass through intermediate stages. Evidently a great saving of time and energy is thus effected.

The pouch is probably to be regarded as a specialization of a primitive simple infolding of the ventral body-wall. The metamorphosis is in reality a sudden and extreme flexure of the larval body, and may be considered as the ontogenetic repetition of a habit of adult ancestral forms.—*Edmund B. Wilson.*

OCCURRENCE OF THE WEB-FINGERED SEA-ROBIN ON THE COAST OF MAINE.—I wish to place on record the occurrence on the coast of Maine of *Prionotus carolinus* (Linn.) Cuv. and Val., the web-fingered sea-robin. I have a specimen which I obtained from a fisherman who took it in a seine with other fishes off Harpswell in Casco bay, on June 26th of this year. The fisherman informs me that another specimen was obtained at the same time.

This species seems never to have been mentioned as occurring so far north before. Storer in his "History of the Fishes of Massachusetts," 1867 (Mem. Amer. Acad.), states that it occasionally occurs in Massachusetts bay. Goode and Bean in their "Catalogue of the Fishes of Essex County, Mass." (Bulletin of the Essex Institute, Vol. XI), mention specimens taken at Salem.—*L. A. Lee, Brunswick, Maine.*

THE LITTLE STRIPED SKUNK CLIMBING.—It may not be uninteresting to know that one alone of the skunk family, so far as I have observed, possesses the faculty of tree climbing; the *Mephitis putorius.* This is a well established fact, as the numerous specimens captured, with one exception, all have been taken from trees, and as the species is common, only less abundant than the *Mephitis mephitica*, the climbing proclivity is too often put to the test for the animal's good. I am not aware that this habit has ever been mentioned in published works; nor do I think that it is known outside of this State.—*G. W. Marnock, Helotes, Texas.*

VORACIOUSNESS OF CHORDEILES POPETUE BAIRD.—While out gunning a few evenings ago, I shot a specimen of the above species, that was flying very low. Just in the dusk of evening, I was surprised to find the bird so heavy and so large. The next morning when I came to take the skin off, I found the cause of the weight and enlargement was principally due to the food the creature had taken. I took from the food sacks as many insects as I could hold in the hollow of one hand, and counted them. To my astonishment I found over six hundred. There were gnats and flies of several species, ants, small beetles and the legs of grasshoppers. I think these birds ought to be encouraged as insect exterminators.—*F. L. Harvey, Ark. Ind. Univ., Fayetteville, Ark.*

LEECHES ON A TURTLE.—To-day I found a turtle thirteen centimeters long and seven centimeters wide, on which were two hundred and forty-nine leeches. One of these, attached to the left side of the neck, was of adult size. The others averaging about three mm. in length in the contracted state were divided in three groups. The largest situated in the fold above the right hind leg. contained one hundred and forty-three. The next above the left hind leg contained ninety-two. The last above the right fore leg contained thirteen.—*Wm. Herbert Rollins, 12 Beacon street, Boston.*

THE ORGANS OF SMELL IN INSECTS.—A recent number of Siebold and Kölliker's Zeitschrift, contains an article by G. Hauser, on the minute structure of the sense organs in the antennæ of different insects, which throws much new light on the functions of the antennæ of insects. He concludes that the organs of smell consist in insects, *i. e.*, all the Orthoptera, Pseudoneuroptera, Diptera and Hymenoptera, also in a large part of the Lepidoptera, Neuroptera and Coleoptera: 1. Of the antennal nerve; 2. Of a terminal perceptive apparatus, which consists of rod-bearing cells arising from hypodermis-cells, with which a nerve-fiber connects; 3. Of an apparatus consisting of a pit or a cone filled with a serous fluid, which are to be considered as simple infoldings and projections of the epidermis. He then discusses the mode of evolution of these organs, considering the fact that the males of all orders of insects have more developed antennæ than the females, the latter being the more sluggish and living in more retired and concealed places, while the males have more active habits, sharper senses, and are more likely to find the females, and thus ensure the maintenance of the species.

ACTION OF ACIDS AND COLOR LIGHT ON MARINE INVERTEBRATES.—M. Yung has recently investigated the effects of alkaline or acid media on Cephalopoda, and with results pretty similar to those of M. Richet with crayfish. The animals are extremely sensitive to the action of mineral acids; where litmus hardly announces the presence of an acid, a young poulpe will immediately give signs of great pain. But more is required to prove fatal. With one cc. in two litres of water, sulphuric, nitric, or hydrochloric acid proved fatal (in from two to four and a half hours) to *Eledone moschata*; but not to oxalic acid. Sulphuric acid was the least toxical of the mineral acids. Of the much less energetic organic acids, tannic acid acts most rapidly. The alkalies range as follows in (decreasing) order of toxical power:—Ammonia, potash, soda, lime, baryta; the action of ammonia being extremely rapid. M. Yung, has also verified, in the main, for marine animals, the results of his former experiments on fresh-water animals, regarding the influence of colored light on animal development; finding violet and blue light stimulant, while red and green retards the growth; yellow comes nearest to white.—*English Mechanic.*

THE THORAX OF THE BLOW FLY.—An essay on this subject by Arthur Hammond, treats especially of the limits of the several segments of the connate thorax of the Diptera. The author enters fully into the history of the different opinions relative to the morphology of the thorax, and then considers the structure of the thorax in other insects. He calls attention to the fact that in the Lepidoptera and Hymenoptera, the development of the segment is proportioned to that of the wings, and shows that the same rule holds good in the Diptera, the metathorax being as obsolete as the

long appendage it carries. He then examines the evidence derived from a study of the muscular and nervous parts, and from the phenomena of development. The work is thoroughly well done, but of such a nature that it cannot be abstracted. The two plates evince excellent artistic skill.

THE SWIMMING-BLADDER OF FISHES.—In a recent note to the Paris Academy, Prof. Marangoni gives the results he has arrived at in a study of the swimming-bladder. He states, first, that it is the organ which regulates the migration of fishes, those fishes that are without it not migrating from bottoms of little depth, where they find tepid water; while fishes which have a bladder are such as live in deep, cold water, and migrate to deposit their ova in warmer water near the surface. Next, fishes do not rise like the Cartesian diver (in the well known experiment), and they have to counteract the influence of their swimming-bladder with their fins. If some small dead and living fishes be put in a vessel three-quarters full of water and the air be compressed or rarefied, one finds in the former case that the dead fish descend, while the living ones rise, head in advance, to the surface. Rarefying has the opposite effect. Fishes have reason to fear the passive influence due to hydrostatic pressure; when fished from a great depth, their bladder is often found to be ruptured. Thirdly, the swimming-bladder produces in fishes twofold instability, one of level, the other of position. A fish, having once adapted its bladder to live at a certain depth, may, through the slightest variation of pressure, be either forced downwards or upwards, and thus they are in unstable equilibrium as to level. As to position, the bladder being in the ventral region, the center of gravity is above the center of pressure, so that fishes are always threatened with inversion; and, indeed, they take the inverted position when dead or dying. This double instability forces fishes to a continual gymnastic movement, and doubtless helps to render them strong and agile. The most agile of terrestrial animals are also those which have least stability.

ZOOLOGICAL NOTES.—From his study of the mollusks of the Challenger expedition, the Rev. R. B. Watson concludes that there are shallow and deep water species, *i. e.*, that depth of water is an important condition of molluscan life; while temperature is a more important condition than depth, the two combined proving barriers to distribution. It appears that where barriers of depth and temperature do not check distribution, there seems, in ordinary circumstances, no limit to universality of distribution, and there are actually existing species whose distribution is cosmopolitan, no barriers having availed against their passage; and, finally, Mr. Watson finds no trace in such species of essential, lasting and progressive change. These views are not new, but interesting as confirmed by recent investigations over the larger part of the

ocean bottom.——Spallanzani's experiments on the regeneration of the head of gasteropods have been confirmed and extended by Carrière, whose experiments show that the eyes, tentacles and labial processes may be completely regenerated, but not the pharynx or the brain, the destruction or removal of which causes the death of the animal.——Bees, wasps, &c., have been found to possess a spur at the apex of the first pair of tibiæ, whose function it is to clean the tongue and perhaps the antennæ also.——An odoriferous apparatus has been discovered by Von Richenau in *Sphinx ligustris*, consisting of a bunch of colorless hair-like scales lying in a fold on each side of the first abdominal segment. According to a notice in the *Journal* of the Royal Microscopical Society, the organ could be extruded from the fold by pressure. The aperture has the form of a cylindrical tube, and here a strong musky scent was perceptible, which did not occur elsewhere. The scales are visible with the naked eye.——Girard's *La Phylloxera* is a little closely-printed brochure of 120 pages, giving a résumé of all that is known in France concerning this dreadful pest. It is accompanied by a map of France, showing the districts more or less infested.——Some points in the developmental history of the lamprey eel are briefly discussed by Dr. W. B. Scott, in *Zoologischer Anzeiger* (Nos. 63, 64). No. 66 of the same useful periodical contains a notice of a viviparous Chirodota (*C. vivipara* = *C. rotifera*).——In our last number Fabre's discovery of parthenogenesis in a wild bee, Halictus, was noticed; we now have to record the discovery claimed by J. A. Osborne, in *Nature* for Sept. 30, of parthenogenesis in a beetle, *Gastrophysa raphani*. Mr. Osborne possessed a living beetle reared from an unfertilized egg.——The embryology of the gar-pike (Lepidosteus) has recently been studied by Messrs. Balfour and Parker, of England, from eggs supplied by Mr. A. Agassiz. They find that the segmentation of the egg is complete as in the sturgeon, and that the nervous system is formed by a solid thickening of the exoderm, as in the bony fishes, and not by the closure of a groove, as in the sturgeon; while the general relation of the embryo to the yolk, and the general characters of the germinal layers are precisely like those in the bony fishes.

ANTHROPOLOGY.[1]

New Archæological Enterprises.—In addition to the successful institutions, both national and local, for the exploration of our American antiquities, two new enterprises have been set on foot with every promise of success, the Archæological Institute of America and the Lorillard Mission [illegible] cities of Central America. Of the former we [illegible] the first annual report of the executive co[illegible] of the houses of the American ab[illegible]

[1]Edited by Prof. Otis T. Mason, Col[illegible]

description of the ancient walls on Monte Leon, Italy, by W. J. Stillman; and archæological notes on Greek shores, by Joseph Thacher Clarke. The plans and scope of the Lorillard expedition are clearly set forth in two articles in the *North American Review* for July and August, to wit, Ruined Cities of Central America, by the editor, Mr. Allen Thorndike Rice; and The Ruins of Central America, by M. Desiré Charnay, who has the exploration in charge. We mention these two works together because they seem to represent the two sides or the two schools of American interpretation with reference to the earthworks of the Mississippi valley, and the ruins of Mexico and Central America. In the introduction of the Archæological Institute Report we read: "The Study of American archæology relates to the monuments of a race that never attained a high degree of civilization, and that has left no trustworthy records of continuous history." Again, we are informed that the committee are in accord with Mr. Morgan, and that they have taken steps to send an agent to Colorado and N. Mexico to observe the Pueblo life, as an introduction to the comprehensive study of Mexico and Yucatan. The fact that Mr. Bandelier is to be that agent is a sufficient guarantee not only of exhaustive work, but of the line of research to be prosecuted. In the Lorillard expedition we are to have "adequate conceptions of the stately edifices of monumental Mitla, or of Palenque, with its magnificent palace, its terraces and temples, its pyramids and sculptured ornaments." It is not the province of the editor to treat with partiality either of these views, but to let the authors speak for themselves.

The Central American undertaking is despatched under the joint auspices of the Government of the United States and of France. The expenses will be defrayed by Mr. Pierre Lorillard, of New York, the original promoter of the enterprise, and by the French Government. The expedition is under the direction of M. Désire Charnay, author of "Cités et Ruines Américaines" (Paris, 1863). It is thoroughly equipped and is provided not only with the means of photographing bas-reliefs and inscriptions, but of making careful casts by the process of M. Lotin de Laval. Copies of these casts will first be presented to the Smithsonian Institution and to the French Government. The collection in France will be named after Mr. Lorillard, and the French Minister has conceded to the *North American Review* the privilege of publishing the earliest accounts from M. Charnay. Mr. Rice in speaking of Uxmal, writes: "It is as yet impossible to determine, with any approach to certainty, the ends which its ruined edifices were designed to serve, but is at least highly probable that they were originally palaces, temples, council-halls and courts of justice; possibly some of them may have been monasteries or community houses, in which the ascetics of a religion analagous to that of Budha lived in common." Again, "These bas-reliefs would of them-

selves appear to be enough to confute the theory according to which Palenque, Uxmal, and the other sites of ruins in this portion of the American continent are only 'pueblos,' groups of 'communal houses,' such as still exist and are still inhabited in New Mexico." M. Le Plongeon copied many beautiful frescoes from the walls of these structures, among them a picture of a frail hut of poles with thatched roof, which he supposed to have been the residence of some of the lower class of people. M. Charnay, who does not scruple to call Bourbourg and Le Plongeon fools, will find it difficult to take good care of his own self-control in a land that has turned the heads of many smart people.

Reverting to Mr. Morgan's paper in the Report of the Archæological Institute, we find that he bases his interpretation of Mexican and Central American architecture upon a study of the communal system of all our aborigines. Commencing with the "long-house" of the Iroquois, the Mandan circular lodge, and the immense structures of the Columbia river tribes, he proceeds to New Mexico and Arizona, where we have in the pueblo the climax of this communal life, and to the works of the Sciota valley, where the earthworks stand for embankments on which to erect long-houses. The pueblos, the mound structures, and the great stone edifices of middle America were joint tenement houses, in the nature of fortresses, and the plan of life within the last named must be sought in the present pueblos, assisted by the light of tradition. At the epoch of the Spanish conquest they were occupied, and were deserted by the Indians to escape the rapacity of the Spanish military adventurers, by whom they were oppressed beyond endurance. Mr. Morgan carefully examines the Casa del Gobernador, and the "House of Nuns," Uxmal, in the light of his own theory. The remarks on the method of constructing vaulted ceilings over a solid core of masonry are exceedingly valuable (p. 66–69). At the close of the article he takes Professor Rau to task for endorsing the palace and city theory of Mr. Stephens, and introduces epithets which we regret to see one American anthropologist using with reference to another. The work of the Archæological Institute is carried on by means of the subscriptions of the members, the annual fee being ten dollars. Those of our readers desiring to correspond with the Institute must address Mr. Edward H. Greenleaf, Museum of Fine Arts, Boston, Mass.

We may be allowed to hint that the simultaneity and succession of the complex elements of civilization are not made out sufficiently to allow one to be dogmatical. It is within the range possibility that the lines of simultaneity may resemble the isotherms rather than the parallels of latitude. In that case communism in living and a gentile system of kinship might coexist with high or a low stage of something else, say the mechanic arts the fabrication of implements. Again, the separation of a people

into the regulative and the operative class may begin lower down in Mr. Morgan's scale than we have thus far been aware of. If so, it is not impossible that the gentile system and communism may have been associated with as much caste as would divide the tribe into the governing and the governed? Far be it from us to detract from the merit of our greatest generalizer in sociology; but it cannot be denied that the argument for the mere communal function of the earthwork and the Central American ruins is based upon analogy only.

JAPANESE MYTHOLOGY.—We are indebted to Prof. E. S. Morse, for the following extract from the Tokio *Times*, of May 22, by J. W. McCarthy:

"In few countries in the world can the adventurous wight who wishes to peer into the future have his desire so easily gratified, and in so many different ways, as in Japan. While in western nations divination is merely a subject of research and speculation amongst scholars, or, at most, is found at intervals in rural districts, far from the busy haunts of men, startling the apostle of nineteenth century civilization with its twelfth century superstition, here in Japan it is a living force, exercising its influence on the trader, the farmer, pilgrim, and even on the course of love itself. Nor is it confined to the poor and lowly; members of the higher classes, and the wealthy, do not disdain to make use of the diviner—and he is equal to the task. For a *tempo* or even a *mon*, he will tell the poor maiden whether her love is faithful, or the coolie whether his pilgrimage will prosper; while for his noble patrons he can perform an elaborate ceremony, in some cases possessing even religious sanctions of the most solemn kind, for which he is quite ready to accept a hundred, five hundred, or even a thousand *yen*.

"On this subject, a passage, almost as applicable to Japan as to China, may be quoted here from Dr. Dennys's little work on the Folk-lore of China.

"'Divination is in China as popular as, and probably more respectable than, it was amongst the Israelites in the days of the witch of Endor, and it is not perhaps going too far to say that there is not a single means resorted to in the West, by way of lifting the impenetrable veil which hides the future from the curious of mankind, which is not known to and practiced by the Chinese. From "Pinking the Bible" to using the Planchette, from tossing for odd and even to invoking spirits to actually speak through crafty media, the whole range of western superstition in this regard is as familiar to the average Chinaman as to the most enthusiastic spiritualists at home. The coincidences of practice and belief are indeed so startling that many will doubtless see in them a sort of evidence either for their truthfulness, or for a common origin of evil.'

"It is not intended at present to describe more than one mode of divination; but it is the mode which is universal among the lower classes, and which can be seen at work every day in the temples of the more corrupt or poorer sects of Buddhists, in Tokio and elsewhere. The materials are very simple. A small rectangular or oblong box is filled with slips of bamboo, each about six inches in length, and having a number written on the end. These can be shaken out, one by one, through a hole in the end of the box; and, according to the number on the first stick, the diviner selects from a drawer in a cabinet, close at hand, a printed slip of paper containing the inquirer's fate. The boxes vary according to age and sex; but the number of boxes in the possession of one temple rarely exceeds sixteen, eight for the various ages, and two for the sexes, with corresponding drawers in the cabinet. The stock in trade being so small, and the divining priest generally holding some other occupation about the temple, he can afford to sell his wares cheaply. Yet on festival days he must receive a large sum. At the temple between Kawasaki and the sea, the writer has seen as many as two hundred persons draw the divining sticks—*Miku-ji wo hiku*, as it is called—in an hour, and all of them seemed to treat the ceremony with the utmost seriousness and solemnity, generally stepping out before drawing the stick, and elevating their hands in prayer to the idol.

"This form of divination seems to be connected with Buddhism, as we find it also used in joss-houses in China. The box and sticks are rarely found among the possessions of an itinerant fortune-teller, and even then he is regarded as an impostor, or a priest who has been discharged for misconduct from his temple. In China, it is said, street fortune-tellers frequently train birds to select these sticks, thus adding an amusing element to the ceremony.

"In conclusion, translations of a few slips of paper, thus selected, may not be uninteresting. It will be observed that the style is somewhat oracular, and the fates decline to descend from the general to the particular. But papers are frequently drawn in which traders are recommended what to invest in and what to avoid:

"'1. *To a man of twenty-eight years*:—At first evil, then good: wealth will be scattered and lost. Misfortune will come suddenly; and quarrels will take place with wife and brethren.

"'2. *To a woman of thirty-seven*:—During spring and summer, the fates are unfavorable; but in autumn and winter things will go well. The expectations of youth will not be realized in old age.

"'3. *To a youth of nineteen*:—This world and the things thereof pass rapidly away, and it is ill to change present occupation for a new one. Sickness, when it comes, will do so with a heavy hand.

"'4. *To a girl of sixteen*:—Disappointment at first, but early

marriage brings early wrinkles: and the countenance of the goddess of mercy will ever afterward be favorable.'

"On another occasion we may possibly describe other forms of divination."

BURIAL OF THE DEAD.—The third in the series of Introductions to the study of the North American Indians, issued by the Bureau of Ethnology of the Smithsonian Institution, is a study of mortuary customs by Dr. H. C. Yarrow, U. S. A. In the preface Major Powell defines the work of the Bureau and the value of a study of mortuary customs in order to comprehend the philosophy of the people among whom they are practiced. Dr. Yarrow, after quoting from a circular issued by him three years ago, containing a series of questions upon burial customs, proceeds to give a classified arrangement of burials, which we produce in full:

1. Inhumation in pits, graves, holes in the ground, mounds, cists, and caves.

2. Cremation, generally on the surface, occasionally beneath, the resulting ashes or the bones being placed in pits, in the ground, in boxes placed on scaffold or trees, in urns, or sometimes scattered.

3. Embalmment, or a process of mummifying, the remains being afterwards placed in the earth, in caves, mounds, or charnel-houses.

4. Aerial sepulture, the bodies being deposited on scaffolds or trees, in boxes or canoes, the two latter receptacles supported on scaffolds or posts, or on the ground.

5. Aquatic burial, beneath the water or in canoes, which were turned adrift.

This order is not observed in the volume, the sub-divisions of the subject occurring as follows: Inhumation; burials in cabins, wigwams, or houses, called "lodge-burial"; stonegraves, or cists; burial in mounds; cave burial; mummies; urn-burial; surface burial; cairn-burial; cremation; partial cremation, by which a clay mold is taken; burial above ground; box burial; tree and scaffold burial; partial scaffold burial, and ossuaries; superterrene and aerial burial in canoes; aquatic burials; living sepulchres (by which is meant exposure to birds and beasts of prey); and cannibalism. The volume of 114 pages is made up of quotations from published works and from the author's correspondence illustrative of the kinds of material which he is most anxious to gather for a large and exhaustive work on mortuary customs. Communications should be addressed to Dr. H. C. Yarrow, Bureau of Ethnology, Washington, D. C.

THE AMERICAN ANTIQUARIAN.—The editor of this journal has widened its scope somewhat by introducing papers on Oriental archæology. Number four concludes the volume and the second year. The contents are as follows:

The pictured caves of La Crosse valley, by Edward Brown.
The theogony of the Sioux, by Stephen R. Riggs.
Teutonic mythology, by Rasmus B. Anderson.
Human sacrifices in ancient times. Trans., by L. P. Gratacap.
Prehistoric relics of Lowndes county, Miss., by Albert C. Love.

In the oriental department we have notes from Selah Merrill, A. H. Sayce and O. D. Miller. The correspondence, editorial notes, archæological notes, linguistic notes, art and architecture, and exchanges are unusually full and valuable.

Mound Relics from Illinois.—Dr. P. R. Hoy, of Racine, Wisconsin, sends us photographs of a cranium taken from one of a group of mounds near Albany, Illinois. The tumuli are on the summit of a high ridge overlooking the Mississippi river. The one from which the skull was exhumed is about eight feet high, and forty feet in circumference. The skeleton was in a sitting posture at the base of the mound, the soil about it being of a darker color than that of the ridge below. On the top of the cranium was an inverted dish, holding about as much as a good sized tea-cup, the depth being just half the diameter. The outside is covered with fine basket markings, and four shields cross-barred, two of them with a central ring, are embossed at equal distances on the outside.

Anthropological News.—The "*Archiv für Antropologie* has introduced a department of abstracts from anthropological literature foreign to Germany. Dr. Emil Schmidt, of Essen, Rhenish Prussia, has charge of that portion relating to America. He is very anxious to receive copies of all publications relating to our special subject. The last number reviews the Peabody Museum, the Davenport Academy, the American Antiquarian, and the Naturalist.

GEOLOGY AND PALÆONTOLOGY.

The Devonian Insects.—Mr. S. H. Scudder has recently published a memoir on the oldest known insects, those found in the Devonian of New Brunswick. The locality from which the specimens were obtained, is not far from the town of St. Johns, from shales very rich in vegetable remains, and was discovered by the late Prof. C. F. Hartt. Six species are described by Mr. Scudder, and as may be supposed, are of considerable interest. A stratigraphic section by Professor J. W. Dawson accompanies the memoir. Mr. Scudder's conclusions are as follows:

"It only remains to sum up the [illegible] examination of the devonian insects, and es[illegible] their relation to later or now existing types. [illegible] a separate consideration of the followin[illegible]

"There is nothing in the st[illegible] insects to interfere with a former [illegible] of wing structure has remai[illegible] Three

of these six insects (Gerephemera, Homothetus, Xenoneura) have been shown to possess a very peculiar neuration, dissimilar from both carboniferous and modern types. As will also be shown under the tenth head, the dissimilarity of structure of all the devonian insects is much greater than would be anticipated; yet all the features of neuration can be brought into perfect harmony with the system laid down by Heer.

"The earliest insects were hexapods, and as far as the record goes, preceded in time both arachnids and myriapods.

"They were all lower Heterometabola.

"They are all allied or belong to the Neuroptera, using the word in its widest sense.

"Nearly all are synthetic types of comparatively narrow range.

"Nearly all bear marks of affinity to the carboniferous Palæodictyoptera, either in the reticulated surface of the wing, its longitudinal neuration, or both.

"On the other hand they are often of more and not less complicated structure than most Palæodictyoptera.

"With the exception of the general statement under the fifth head they bear little special relation to carboniferous forms, having a distinct facies of their own.

"The devonian insects were of great size, had membranous wings and were probably aquatic in early life. The last statement is simply inferred from the fact that all the modern types most nearly allied to them are now aquatic.

"Some of the devonian insects are plainly precursors of existing forms, while others seem to have left no trace. The best examples of the former are Platephemera, an aberrant form of an existing family; and Homothetus which, while totally different in the combination of its characters from anything known among living or fossil insects, is the only palæozoic insect possessing that peculiar arrangements of veins found at the base of the wing in Odonata typified by the arculus, a structure previously known only as early as the Jurassic. Examples of the latter are Gerephemera, which has a multiplicity of simple parallel veins next the costal margin of the wing, such as no other insect ancient or modern is known to possess; and Xenoneura, were the relationship of the internomedian branches to each other and to the rest of the wing is altogether abnormal.

"If, too, the concentric ridges, formerly interpreted by me as possibly representing a stridulating organ, should eventually be proved an actual part of the wing, we should have here a structure which has never since been repeated even in any modified form.

"They show a remarkable variety of structure, indicating an abundance of insect life at that epoch.

"The devonian insects also differ remarkably from all other

known types, ancient or modern; and some of them appear to be even more complicated than their nearest living allies.

"We appear, therefore, to be no nearer the beginning of things in the devonian epoch than in the carboniferous, so far as either greater unity or simplicity of structure is concerned; and these earlier forms cannot be used to any better advantage than the carboniferous types in support of any special theory of the origin of insects.

"Finally, while there are some forms which, to some degree, bear out expectations based on the general derivative hypothesis of structural development, there are quite as many which are altogether unexpected, and cannot be explained by that theory without involving suppositions for which no facts can at present be adduced."

AMERICA'S COAL SUPPLY.—Mr. P. W. Sheafer, of Pottsville, writes as follows respecting the supply of coal of the United States, and the methods of mining it: The coal resources of Great Britain are all developed now, and in process of depletion; whilst in this country when our four hundred and seventy square miles of anthracite are exhausted, we have more than four hundred times that area, or 200,000 square miles of bituminous, from which to supply ourselves and the rest of mankind with fuel. The coal product of the world is about 300,000,000 tons annually. The North American continent could supply it all for two hundred years. With an annual production of 50,000,000, it would require twelve centuries to exhaust the supply. But with a uniform product of 100,000,000 tons per annum, the end of the bituminous supply would be reached in eight hundred years. What the annual consumption will be when this continent supports a teeming population of 400,000,000 souls, as will be the case some day, must be left to conjecture. But with half that population, as energetic, restless and inventive as our people in this stimulating climate have always been, under the hopes of success, such a country as this constantly holds out to tempt ambition and reward enterprise, it is a very moderate estimate, guided by the actual output already reached in Great Britain, to suppose that there will be ample use for one hundred million tons a year of bituminous coal for home consumption alone.

We have about three hundred and forty collieries, and produce 20,000,000 tons per annum, or about 60,000 tons each. Great Britain has nearly four thousand collieries, and mines 132,000,000 tons, or 33,000 tons per colliery. The greater the yield per colliery the less the expense in mining. If we decrease the number of mines and increase their capacity not only to raise the coal, but to exhaust a constant current of foul air and dangerous gases, clouds of powder smoke and millions of gallons of water, we will reduce the cost of mining. Most of the anthracite mining in the United States is now done at a less depth than five hundred feet

vertical; but as the coal nearer the surface becomes exhausted, the mines must go deeper and become more expensive.—*Proceedings of the American Association for Advancement of Science, 1879.*

THE NORTHERN WASATCH FAUNA.—The following species have been received from Mr. Wortman from the beds of the Wind River group, subsequent to the publication of my last notice of his discoveries:[1] (1) *Esthonyx spatularius*, sp. nov. Represented by five molar and premolar, and two incisor or canine teeth, apparently belonging to one individual. These are about the size of those of *E. bisulcatus*, but present several differences of detail. Thus the basin of the heel of the last inferior molar is not obliquely cut off by a crest which extends forwards from the heel, but is surrounded by an elevated border, which rises into a cusp on the external side. The incisor-canine teeth are more robust than those of *E. bisulcatus*, one of them especially having a spoon-shaped crown with the concave side divided by a longitudinal rib, on which the enamel is very thin. The enamel descends much further down on the external than the internal side of these teeth. The rodent-like tooth does not accompany the specimen. Length of base of last inferior molar, .009; width anteriorly, .005; length of crown of canine-incisor No. 1. .009; width of do. at base, .005; length of crown of second canine-incisor at base, .012; width of do., .006. (2) *Didymictis leptomylus;* represented by the posterior three inferior molars. These indicate a species of smaller size than the *D. protenus*, with the tubercular molar relatively narrower, and perhaps longer. The anterior part of the latter has the three cusps well defined and close together, and behind them is an oblique longitudinal cutting edge. The middle of the posterior margin rises into a tubercle. The anterior cusps of the tubercular sectorial are elevated; the heel has a strong external cutting edge and internal ledge. Length of tubercular sectorial, .009; width of do., .005; length of tubercular, .007; width of do. in front .0035. (3) *Hyopsodus speirianus*, sp. nov. Founded on a portion of a mandibular ramus supporting the last three molars in perfect preservation. It is distinguished by its very small size, since it is considerably less than the *H. vicarius (H.? minusculus)*, and by the equality in size of the molars. The heel of the third molar is very small, and the two cones of the inner side of the crowns of all the molars are acute. The external crescents are very well defined; the anterior sending a horn round the anterior extremity of the crown. The posterior is connected with the corresponding internal tubercle by a median conic posterior tubercle. Length of true molar series, .008; length of second molar, .0026; width of do., .0022; length of last true molar, .0025; width of do., .0016. Depth of ramus at second molar, .0043. Dedicated to my friend Mr. Francis Speir, of Princeton, N. J., who, in connection with

[1] NATURALIST, Oct. (Sept.), 1880, p. 745.

Messrs. Scott and Osborne, has made important additions to our knowledge of the Eocene *Vertebrata*.—*E. D. Cope.*

GEOLOGICAL NEWS.—Mr. Hébert has recently published in the *Comptes Rendus* an account of the geology of the British Channel.——The last number of the Palæontographica contains two important memoirs: Roëmer on a Carbonaceous chalk formation of the West Coast of Sumatra; and Branco on the development of the extinct *Cephalopoda*.——M. Filhol having finished his work on the extinct *Vertebrata* of San Gerand le Puy, is about to publish one on those discovered at Ronzon.——The Powell Survey has just published Capt. Dutton's report on the Central Plateaus of the Colorado drainage.

GEOGRAPHY AND TRAVELS.[1]

PROCEEDINGS OF THE GEOGRAPHICAL SECTION OF THE BRITISH ASSOCIATION.—The British Association for the Advancement of Science, held its fiftieth meeting at Swansea from the 25th of August to the 1st of September. The President of the Geographical Section, Lieutenant General Sir J. H. Lefroy, F. R. S., in his opening address, spoke at length on the progress of discovery on our own continent.

In other regions geography was the pioneer of civilization and commerce. Here for the first time she had been outstripped, for the telegraph and the railway had tracked the forest or prairie, and traversed the mountains by paths before unknown to her.

Within living memory no traveler known to fame had crossed the American continent from East to West except Andrew Mackenzie in 1793. No traveler had reached the American Polar sea by land except the same illustrious explorer and Samuel Hearne. The British Admiralty had not long before instructed Captain Vancouver to search on the coast of the Pacific for some near communication with a river flowing into or out of the Lake of the Woods.

In proceeding to notice the extensive explorations and surveys undertaken by the Government of the United States and of Canada, he alluded to the great aid afforded the former by the physical features of the region of their trigonometrical survey where sharp rocky peaks, bare of vegetation, rise to altitudes of 10,000 to 12,000 feet at convenient distances, in an atmosphere of singular purity; whilst in the British territory a vast region, wholly wanting in conspicuous points, is to be laid out in townships of uniform area. The law required that the eastern and western boundaries of every township be true astronomical meridians, and that the sphericity of the earth's figure be duly allowed for, so that the northern boundary must be less in measurement than the southern. All lines are required to be gone over twi

[1] Edited by ELLIS H. YARNALL, Philadelphia.

with chains of unequal length, and the land surveyors are checked by astronomical determinations. In carrying out this operation, which will be seen to be one of great nicety, five principal meridians have been vigorously determined, and in part traced—the 97th, 102d, 106th, 110th and 114th; and fourteen base lines connecting them have been measured and marked. One of these, on the parallel of 52° 10′, is one hundred and eigthy-three miles long. The sources of the Frazer river were first reached in February, 1875, and found in a semi-circular basin completely closed in by glaciers and high base peaks at an elevation of 5300 feet. The hardy discoverer, Mr. E. W. Jarvis, traveled in the course of that exploration nine hundred miles on snow shoes, much of it with the thermometer below the temperature of freezing mercury, and lived for the last three days, as he expresses it, "in the anticipation of a meal at the journey's end." We are still imperfectly acquainted with the region north of the parallel of 50° in British Columbia, where the Canadian engineers have long been searching for a practicable railway line from one or other of the three known passes of the Rocky mountains proper through the tremendous gorges of the Cascade mountains to the Pacific. These passes are, the Yellowhead at an elevation of 3645 feet, the Pine river at 2800 feet, and the Peace river said to be only 1650 feet above the sea. The Dominion Government has recently adopted a line from the Yellowhead pass to Burrard inlet, which may be made out on any good map by following the course of the Thompson and Frazer rivers.

Dr. Dawson has recently explored the Queen Charlotte islands. He regards them as a partially submerged mountain chain, a continuation northwestward of that of Vancouver's island, and of the Olympian mountains in Washington territory. An island one hundred and fifty-six miles long and fifty-six wide, enjoying a temperate climate, and covered with forests of timber of some value (chiefly *Abies menziesii*) is not likely to be left to nature much longer.

The Abbé Petitot has recently made some remarkable explorations in the Mackenzie river district, between the Great Slave lake and the Arctic sea. Starting sometimes from St. Joseph's mission station, near Fort Resolution on Great Slave lake; sometimes from St. Theresa on Great Bear lake; sometimes from Notre Dame de Bonne Espérance on the Mackenzie, points many hundreds of miles asunder, he has, on foot or in canoe, often accompanied only by Indians or Esquimaux, again and again traversed that desolate country in every direction. He has passed four winters and a summer on Great Bear lake and explored every part of it. He has navigated the Mackenzie ten times between Great Slave lake and Fort Good Hope, and eight times between the latter post and its mouth. We owe to his visits in 1870 the disentanglement of a confusion which existed between the mouth of the Peel river (R. Plumée), and those of the Mackenzie owing

to their uniting in one delta, the explanation of the so-called Esquimaux lake, which, as Richardson conjectured, has no existence, and the delineation of the course of three large rivers which fall into the Polar sea in that neighborhood, the "Anderson" discovered by Mr. Macfarlane in 1859, a river named by himself the Macfarlane, and another he has called the Roncière. Sir John Richardson was aware of the existence of the second of these, and erroneously supposed it to be the "Toothless Fish" river of the Hare Indians (Beg-hui-la on his map). M. Petitot has also traced and sketched in several lakes and chains of lakes, which supports his opinion that this region is partaking of that operation of elevation which extends to Hudson's bay. He found the wild granite basin of one of these lakes dried up and discovered in it, yawning and terrible, the huge funneled opening by which the waters had been drawn into one of the many subterranean channels which the Indians believe to exist here.

These geographical discoveries are but a small part of l'Abbé Petitot's services. His intimate knowledge of the languages of the Northern Indians has enabled him to rectify the names given by previous travelers, and to interpret those descriptive appellations of the natives which are often so full of significance. He has profoundly studied their ethnology and tribal relations, and he has added greatly to our knowledge of the geology of this region.

It is, however. much to be regretted that this excellent traveler was provided with no instruments except a pocket watch and a compass, which latter is a somewhat fallacious guide in a region where the declination varies between 35° and 58°. His method has been to work in the details brought within his personal knowledge or well attested by native information on the basis of Franklin's charts.

M. Petitot expresses his opinion that the district of Mackenzie river can never be colonized—a conclusion no one who has visited it will be disposed to dispute; but he omits to point out that the mouth of that river is about seven hundred miles nearer the post of Victoria, in British Columbia, than the mouth of the Lena is to Yokohama, and far more accessible. It needs no Nordenskiöld to show the way. Its upper waters, the Liard, Peace, Elk and Athabasca rivers, drain an enormous extent of fertile country not without coal or lignite and with petroleum in abundance. As the Canadian geological survey has not yet been extended so far, we are not fully acquainted with its mineral resources; but the speaker adds his testimony to that of more recent travelers as to the remarkable apparent fertility and the exceptional climate of the Peace river valley.

As regards the extent to which the soil is now permanently frozen round the North Pole, Sir Henry Lefroy states that Erman, on theoretical grounds, affirms that the ground at Yakutsk is frozen to a depth of six hundred and thirty feet. At fifty feet be-

low the surface it had a temperature of 28° 5 F. and was bare up to the freezing point at three hundred and eighty-two feet is very different on the American continent. The rare oppo tunity was afforded me by a landslip on a large scale in Ma 1844, of observing its entire thickness near Fort Norman, on t Mackenzie river, about two hundred miles further north th Yakutsk, and it was only forty-five feet. At York factory a Hudson's bay it is said to be about twenty-three feet. The rec extension of settlements in Manitoba has led to wells being su in many directions, establishing the fact that the permanen frozen stratum does not extend so far as that region, notwi standing an opinion to the contrary of the late Sir George Sim son. Probably it does not cross Churchill river, for Sir H. L froy was assured that there is none at Lake à la Crosse. It d pends in some measure on exposure.

In the neighborhood of high river banks, radiating their he in two directions, and in situations not reached by the sun, t frost runs much deeper than in the open. The question, howev to which Sir John Richardson called attention so long ago 1839, is well deserving of systematic inquiry, and may even thr some light on the profoundly interesting subject of a geograp cal change in the position of the earth's axis of rotation.

The Saskatchawan is now navigated from the Grand Rapi near Lake Winnipeg to the base of the Rocky mountains. T impediments to navigation on the Nelson river have been fou to be insuperable, and a company has been formed to make a ra way from the lowest navigable point to the mouth of the Churc hill river.

The land around Hudson's bay is rising at the rate of five ten feet in a century, The mouth of the Churchill affords far s perior natural advantages for shipping the agricultural products the Northwest territory than York Factory.

MICROSCOPY.[1]

THE NATIONAL SOCIETIES.—The American Society of Micr scopists, held its third annual meeting at Detroit, on the 17th 19th, of August last, under the presidency of Prof. H. L. Smit of Geneva, New York. Regular morning and afternoon sessio were held during the three days; and, in all, fourteen papers we read, eight on microscopy proper, and six on natural history su jects connected with the use of the microscope. Included in t latter number is the very elaborate and interesting Presiden Address, delivered by Prof. Smith, on the subject of Deep S Life. A soirée was held in a public hall one evening, which w well attended, and was as fully calculated to accomplish its obje of public entertainment and popular instruction in the powers a application of the microscope, as could reasonably be expect

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

under the disadvantage of very limited time and opportunities for preparation. No executive business of very general interest and radical importance was transacted, except, perhaps, the adoption of a rule prohibiting the publication elsewhere of papers read before the Society in advance of their appearance in the official proceedings; an experiment which is not likely to be successful, as its operation, if persisted in, will, according to the experience of other organizations, greatly limit the activity of the Society itself without materially increasing the importance attached to its printed proceedings. Mr. J. D. Hyatt, of New York, was elected president, and the time and place of holding the next annual meeting were left to the selection of the executive committee.

The American Association for the Advancement of Science met in Boston on the following Wednesday, August 25th, and continued in session for eight days. It is safe to say that no such meeting of scientists has ever been held in this country before, or is likely to be soon held again. A thousand members were in attendance, including names notable in every branch of science; two hundred and eighty papers were presented, extending over a wide range of subjects, and many of them of universal interest; while the thoughtful and lavish hospitality of the citizens of Boston and vicinity rendered the week of the meetings an ovation, from beginning to end. Of such a vast enterprise, the subsection of microscopy would necessarily be a small though not unimportant fraction. Under the chairmanship of Prof. S. A. Lattimore, of Rochester, and with the able assistance of the Boston Microscopical Society, the best of arrangements were made, and formal meetings were held on three different days, at which meetings fourteen papers were read, eight upon microscopy proper, and six upon natural history subjects connected with the use of the microscope. In addition to these, many valuable microscopical papers were read at various times, in other sections, in connection with botany, entomology, etc., to say nothing of unlimited opportunities of intercourse with persons distinguished in related branches of science, of hearing papers and discussions on other subjects, and of enjoying the general privileges of a memorable week. Much field work was done by various members, on the seashore and elsewhere. A soirée was given at the usual rooms of meeting, during one evening, but no attempt was made to render it a popular exhibition. Rev. A. B. Hervey, of Taunton, Massachusetts, was elected chairman for the next meeting, which will be held at Cincinnati.

Probably no thoughtful person who attended both meetings this summer, the American Society of Microscopists at Detroit, and the subsection of microscopy, A. A. A. S., at Boston, failed to notice the nearly equal division of strength between the two conventions. The personal attendance at the meetings was about equal, though mainly of different individuals; the number of papers read was

precisely the same, and it is only fair to say that in interest an importance they were very evenly divided. It is obvious that i the strength of the two meetings could have been combined i one, the result would have been far more adequate and satisfac tory. This reflection has derived force from the well known fac that in the Microscopical Congress at Indianapolis, nearly half th voices were in favor of joining with the A. A. A. S., instead o forming a separate society, the latter course being adopted in th critical vote by a majority of one. From first to last, it has bee of great and conceded importance to combine all our strength i one enterprise; but the obstacles which originally rendered thi impossible, still remain, and it is evident that indiscreet contro versy might increase and perpetuate the difficulties it was de signed to remove. It would be absurd to ask persons accustome to attend the meetings of the great society, and highly valuing it opportunities for intercourse with a large number of leading minds in various departments of science, to abandon that for any narrow organization, however attractive might be its field On the other hand the new society could not profitably be unite with the old, as has been proposed, without a more cordial an general support of such a procedure than could at present b hoped for. The subordination to greater interests, which woul be encountered in uniting with the great society, would be mor than counterbalanced, in many minds, by the social and scientifi advantages gained; and the fact that many of the papers rea would be excluded from the Proceedings by a necessity whic admits only contributions new to science, would be of little con sequence, since popular papers gain an earlier and a wider distr bution through the popular journals; but a more serious difficult arises from the localities in which the meetings of the A. A. A. S are sometimes held. The large and powerful society can affor to appoint meetings, not unfrequently, for the sake of cultivatin local interest in science, in localities which would be unavailabl for the microscopical meetings. A joint meeting at Boston woul have given a large increase of vitality; the same will not b equally true of all other localities.

If for these or any other reasons, it should be impracticable t combine the two societies at present, the greatest advantage would doubtless be secured by such a policy as would show, o both sides of the question, a reasonable and considerate regard fo the interests of the other. The very large minority at Indianapo lis acquiesced in the formation of a new society with the under standing that the times and places of meeting were to be s chosen as to best accommodate those who might wish to atten both. This policy, if fully carried out, would not prevent meetin at the same place when expedient, and would not require it whe some other correlated place would be advisable. It would giv many of the advantages of union, with entire freedom from it

difficulties. It is the least that could in reason be asked, or that could in common courtesy be granted as a means of securing a cordial and harmonious support for the new society.

New Local Societies.—The Central New York Microscopical Club was organized some months since, at Syracuse, New York.

The Lancaster, Pennsylvania, Microscopical Society, J. W. Crumbaugh, M. D., president, was organized February 9th.

The Elmira Microscopical Society was organized May 13th, with S. O. Gleason, M.D., for president, and D. R. Ford, Ph.D., vice-president, and T. J. Up de Graff, M. D., secretary and treasurer.

The Fort Wayne Microscopical Society held its first meeting, September 18th, with F. W. Kuhne, president, C. A. Dryer, M.D., and C. W. McCaskey, M. D.; vice-presidents, C. L. Olds and L. R. Hartman, secretaries, and Paul Kuhn, treasurer.

The Microscopical Society of Central Illinois was organized at Springfield, Illinois, September 23d, F. L. Matthews, M. D., being the first president, and T. B. Jennings, secretary.

The Reading, Pennsylvania, Society of Natural Sciences, which has been in existence for over ten years, held a series of microscopical meetings, of the soirée order, last winter, which were quite successful, and which will probably be continued.

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SCIENTIFIC NEWS.

— At the late meeting of the American Association at Boston, Prof. A. Hyatt gave a popular lecture on the transformation of Planorbis as a practical illustration of the evolution of species. The lecture was illustrated with stereopticon views. After the lecture Mr. Carl Seiler threw some microscopical illustrations upon the screen. Prof. Hyatt spoke substantially as follows: The word evolution means the birth or derivation of one or more things or beings from others, through the action of natural laws. A child is evolved from its parents, a mineral from its constituents, a state of civilization from the conditions and surroundings of a preceding age. While evolution furnishes us with a valuable working hypothesis, science cannot forget that it is still on trial. The impatience of many when it is doubted or denied, savors more of the dogmatism of belief than of the judicial earnestness of investigation. Every individual differs in certain superficial characters from the parent forms, but is still identical with them in all its fundamental characteristics. This constantly recurring relationship among all creatures is the best established of all the laws of biology. It is the so-called law of heredity, that like tends to reproduce like. There seems to be only two causes which produce the variations which we observe; one is the law of heredity, the other is the surrounding influences or the sum of

the physical influences upon the organism. The first tends to preserve uniformity, the second modifies the action of the first. The law of natural selection asserts that some individuals are stronger and better fitted to compete with others in the struggle of life, than are others of the same species; hence they will live and perpetuate their kind, while the others die out. An erroneous impression exists that Darwinian doctrines are more or less supported by all naturalists who accept evolution, but it is far from the truth. The Darwinian hypothesis is so very easy of application, and saves so much trouble in the way of investigation, that it is very generally employed without the preliminary caution of a rigid analysis of the facts, and it is safe to say that it is often misapplied. A great amount of nonsense has been written about its being a fundamental law, in all forgetfulness that we are yet to find a law for the origin of the variations upon which it acts; it cannot be the primary cause of the variations, for the laws of heredity are still more fundamental. The speaker then described the situation and character of Steinheim, where numerous shells of the Planorbidæ are found in the strata, which have been very regularly deposited. Hilgendorf claims to have discovered great evidences of the gradual evolution of the various forms from the simplest and oldest specimens, but Mr. Hyatt has failed to find what Hilgendorf describes. By means of a lantern a number of illustrations of the shells were projected upon a screen and quite fully described. Four lines of descendants were shown to branch out from four of the simplest forms, with all the gaps between the species filled with intermediate varieties. Each one of the lines or series has its own set of characteristic differences, and its own peculiar history. It is a fair inference from the facts before us, that the species of the progressive series, which become larger and finer in every way, owe their increase in size to the favorable physical condition of the Steinheim basin. Darwinists would say that in the basin a battle had taken place, which only the favored ones survived. Mr. Hyatt endeavored to present, in a popular manner, the life-history of a single species, the *Planorba lævis*, and its evolution into twenty or thirty distinguishable forms, most of which may properly be called by different names and considered as distinct species. He also endeavored to bring the conception that the variations which led to these different species were due to the action of the laws of heredity, modified by physical forces, especially by the force of gravitation, into a tangible form. There are many characteristics which are due solely to the action of the physical influences which surround them; they vary with every change of locality, but remain quite constant and uniform within each.

— Dr. E. L. Trouessart communicates a valuable essay in defence of the doctrine of derivation to No. 16 (October) of the *Revue Scientifique*. He states the position of the objectors to

this doctrine to consist in the assertions, that (1) no palæontologist has shown the transition of one species into another; and (2) that the geological record should furnish the history of such changes had they taken place. To this the author of the paper replies (1) that many intermediate forms connecting widely separated living types have been discovered by palæontologists. (2) That the geological record is too imperfect to furnish all the transitions that the theory of derivation requires. (3) That observation of actual transition is not necessary in evidence, since there is reason to believe that transformations have proceeded more rapidly under some circumstances than others, and through changes transpiring during embryonic life. In support of the latter hypothesis, he cites the writings of Dall (1877) and Selys Longchamps (1879) on *Saltatory Evolution*.

— An interesting discovery has been made at Edge Lane quarry, Oldham, England. The quarrymen, in the course of their excavations, have come upon what has been described as a fossil forest. The trees number about twelve, and some of them are two feet in diameter. They are in good preservation. The roots can be seen interlacing the rock, and the fronds of the ferns are to be found imprinted on every piece of stone. The discovery has excited much interest in geological circles round Manchester, and the "forest" has been visited by a large number of persons. The trees belong to the middle coal measure period, although it has been regarded as somewhat remarkable that no coal has been discovered near them. The coal is found about two hundred and fifty yards beneath. Prof. Boyd-Dawkins, of Owens College, has visited the quarry.—*London Times.*

— Dr. Asa Gray left London for Paris last month, and is probably now botanizing in Spain.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History, Oct. 6.—Mr. S. H. Scudder gave an account of the geology and palæontology of the Lake basin of Florissant, Colorado, famous for its insect and plant remains.

Oct. 20.—Mr. J. A. Allen spoke of the distribution of the birds of the West Indies, with special reference to those of the Caribbee islands. The President showed specimens of the carboniferous centipede, Euphoberia, some of gigantic size, and discussed their relationship to living and extinct types. Dr. W. F. Whitney described the structure of the so-called "sucking stomach" of Butterflies.

Nov. 3.—Prof. E. S. Morse spoke on the Ainos of Yesso, showing some of their implements, etc.; Mr. Scudder exhibited an in-

teresting carboniferous fossil from Illinois; Mr. Hyatt descr the molting of the lobster; while Mr. Putnam showed a rem able piece of pottery from an Arkansas mound, and referre the supposed resemblances between the pottery from these mo and from Peru.

New York Academy of Sciences, Oct. 11.—Mr. A. A. J gave the results of recent observations on mountain-sculptu the Catskills.

Oct. 18.—Prof. Newberry described the great deposits of talline iron ore in Southern Utah; and Prof. Martin exhibitec read notes upon specimens of the fossil leaves contained ir tufa of Brazil.

Oct. 25.—Prof. T. Egleston read a paper on American cesses for the manufacture of copper.

Appalachian Mountain Club, Boston, Oct. 13.—Prof. G. L gave an account of a sojourn in Andover, Maine. Mrs. I Pychowska described Bald hill, Campton, N. H. Carter d Huntington ravine and the Montalban ridge were describe Mr. W. H. Pickering; and Prof. C. E. Fay remarked upon a culiar feature of Mt. Lincoln, Franconia mountains, N. H.

Middlesex Scientific Field Club, Oct. 13.—The Club its first regular meeting since its adjournment for the sum months. L. L. Dame read a paper on the "Preservation of Native Plants." The reading was followed by discussions.

Nov. 3.—The President, Henry L. Moody, read a paper "Mimicry of Insects." The Club adopted measures lookin the establishment of a museum to illustrate the Natural His of Middlesex county.

American Philosophical Society, Philadelphia, March 1 A communication was received, entitled "Nodal estimate of Velocity of Light, by P. E. Chase." Mr. Phillips read a paper scribing two very old and curious maps of North and So America. Dr. Greene communicated a paper "On the actio hydrochloric acid and of chlorine on acetobenzoic anhydride.

April 2.—A paper was read, entitled "On the Origin of Plane by Daniel Kirkwood.

April 16.—Mr. Hall described casts from the State Geolog Museum.

May 7.—Mr. Robinson read a biographical memoir of the M. Michel Chevalier. A paper entitled "Second Contributio the History of the *Vertebrata* of the Permian formation of Te by E. D. Cope," was presented.

May 21.—Mr. Phillips presented a paper on "Some recent coveries of Stone Implements in Africa and Asia." Prof. C remarked on the Lower Tertiary formations.

June 18.—Mr. Blodgett made some observations on "Certain features of industrial migrations."

July 16.—Prof. Cope presented a paper "On the Genera of the *Creodonta.*"

Aug. 20.—Two papers were presented, entitled "Notes respecting a re-eroded channel-way" and "Notes on some features of the Geology of Scott and Wise counties, Va.," by J. J. Stevenson.

Sept. 17.—Mr. H. G. Jones presented a paper entitled "Notes on the Cumberland or Potomac Coal basin." Mr. Lesley proposed another Egyptian etymology in Greek, viz, the name of the Eleusinian Sun God, *Ιακχος* from aχu in the Sphinx name of the Nilotic morning sun god Horus:—Hor-m-aχu, The sun on the horizon.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

Quarterly Journal of Microscopical Science—October. Larval Forms: their nature, origin and affinities, by F. M. Balfour. (An attempt to study the relations of the larvæ of Echinoderms, mollusks and worms, and to determine the characters of the common prototype, Pilidium coming nearest to this form in the course of its conversion into a bilateral form; the Trochosphere being a completely differentiated bilateral form in which an anus has become developed. The bilateral symmetry of the larva of Echinoderms is supposed to be secondary, like that of many Cœlenterate larvæ.) The Eye of Pecten, by S. J. Hickson. (Its anatomy is exceedingly complicated, and exhibits all the most important structural elements of the eyes of the higher Vertebrata, but the mode of formation of the molluscan eye is essentially different from that of the Vertebrata, and the resemblance in the adult is merely accidental, not homological. The Pecten is probably capable of appreciating very diffused light, for the close approximation of the lens to the retina makes it exceedingly improbable that any image is formed upon the latter; so that its visual power would not enable it to avoid its enemies.) On the terminations of nerves in the epidermis, by L. Ranvier. On the termination of the nerves in the mammalian cornea, by E. Klein.

Annales des Sciences Naturelles, August. On the Metamorphoses of Bryozoa, by J. Barrois. Researches in the fauna of southern regions, by A. Milne-Edwards (based on the geographical distribution of the penguins, with a map and plate).

Zeitschrift für Wissenschaftliche Zoologie—Sept. 10. The anatomy of *Distomum hepaticum*, by F. Sommer (richly illustrated). Description of the nervous system of *Oryctes nasicornis* in the larva, pupa and beetle stages, by H. Michels (elsewhere noticed).

Jenaische Zeitschrift für Naturwissenschaft—October 5. On the direction of the pollen tubes in the Angiosperms, by M. Dalmer. On the gill-bearing Tritons, by O. Hamann.

American Journal of Science and Arts—November. Remarkable marine Fauna occupying the outer banks off the southern coast of new England, by A. E. Verrill. Revision of the land snails of the Paleozoic era, with descriptions of new species, by J. W. Dawson. Extension of the Carboniferous Formation in Massachusetts, by W. O. Crosby and G. H. Barton.

Psyche, Cambridge—July. Chemical change of coloration in Butterfly's wings, by W. H. Edwards and J. M. Wilson.

August.—The Trophi and their chitinous supports in Gracillaria, by G. Dimmock. With the usual bibliographical record, so valuable a feature of this journal.

Geological Magazine—October. Volcanic Eruption and Earthquakes in Iceland within historic times, by T. Thoroddsen.

The Fifteenth Volume of the American Naturalist.—We would call the attention of our subscribers to the fact that the present volume contains 926 pages, or 120 more than the preceding volume.

We shall continue the coming year the reviews of progress in different departments of natural science, and from the papers in hand and those promised can give the assurance that Volume XV, will, at least, not be inferior in variety and interest to its predecessors.

As during the past fourteen years, we continue to invite the contributions of original notes and articles, and items of scientific news, and ask our friends to call the attention of those in any way interested in natural history to our magazine, as an aid and stimulus in their reading and observations in the field. The larger our subscription list, the more matter and illustrations can we offer to our patrons.

We have pleasure in announcing the purchase of the subscription list and good will of the "American Entomologist," which will in future be represented by a new department of the NATURALIST, to be devoted exclusively to Entomology. It will be conducted by the distinguished scientist, Dr. C. V. Riley, whose accession to our editorial corps, we think, constitutes an important era in the history of the AMERICAN NATURALIST.

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Errata.—On page 64, for Ogoowé read Ogowé; page 144, for Naverbine read Nambwe.

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